Electronic Services - Hayward, Ca
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IRD

INSTRUCTION MANUAL
FOR
MODEL 345
VIBRATION ANALYZER / DYNAMIC BALANCER

INSTRUCTION MANUAL
FOR
MODEL 345
VIBRATION ANALYZER / DYNAMIC BALANCER

Part No. 12183
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D Mechanalysis, Inc.
sidiary of H. H. Robertson Company
50 Huntley Road Columbus, Ohio 43229

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF MANUAL

Conditions in a machine that eventually result in breakdown and extensive repairs can be detected by the vibration they cause. An increase in the severity of such mechanical troubles is revealed by increased vibration. These vibrations are often complex and require a capability to separate one from the other if the trouble is to be found. The IRD Model 345 Vibration Analyzer/Dynamic Balancer not only has this capability but is equally suited for in-place dynamic balancing.

This manual is written to provide you with an understanding of how to set up and operate this instrument. For details on its application, IRD has available a comprehensive training program which covers vibration measurement, analysis, identification, and dynamic balancing. Using the latest techniques, the IRD Audio-Visual Training Program is conducted in principal cities throughout the USA and Canada at no charge to you. For further details, contact your nearest IRD office.

1.2 PURPOSE AND CAPABILITY OF MODEL 345 INSTRUMENT

The Model 345 Vibration Analyzer/Dynamic Balancer is a compact, lightweight instrument. It is ruggedly constructed for continuous industrial use. This instrument can be powered from either the AC supply voltage (117 or 234 volt) or from its built-in rechargeable battery.

The Model 345 can be taken to the job site for performing vibration analysis or in-place balancing of fans, blowers, pumps, rolls, centrifuges, grinding wheels, and other rotating equipment. Unbalance is the most common cause of vibration found in rotating equipment. Vibration caused by unbalance can damage machine rotors, bearings, and support structures. Properly balanced rotating machinery will provide safe, smooth, quiet, and long lasting machine operation. The 345 instrument meets all the requirements needed for obtaining this operation.

The Model 345 instrument is equipped with a vibration pickup, a strob light, interconnecting cables, and a rechargeable battery. Dual pickup inputs are provided for performing two-plane balancing.

IMPORTANT NOTICE FOR PROPER CARE OF BATTERIES

1. Maintain batteries fully charged & avoid complete discharge.
2. Recharge (14-18 Hrs) if Ampl. Meter reads below ~ in TEST.
3. Recharge after each use in BATTERY, and before storing.
4. See instructions on Page 3-3 and 5-2 of manual.

2.0 DESCRIPTION OF MODEL 345 INSTRUMENT

2.1 DESCRIPTION OF CONTROLS METERS AND RECEPTACLES

The IRD Mechanalysis Model 345 Vibration Analyzer/Dynamic Balancer is an instrument for measuring the amplitude and frequency of vibration at any two positions on a rotating machine. Amplitude is read out in either vibrational Velocity or Displacement. Frequency is read out in Cycles Per Minute (CPM). Solid-state devices and simplified operating controls used in the Model 345 instrument provide a portable, dependable, but economic instrument for performing vibration analysis or in-place balancing of various types of rotating equipment.

Controls of the 345 instrument are conveniently located and clearly labeled on the Control Panel. By utilizing these controls along with Setup and Operating instructions provided in this manual, properly trained personnel can quickly learn to perform vibration analysis or to perform in-place balancing on rotating machines.

The 345 controls are located on the instrument Control Panel as shown in Figure 2-1. These controls are as follows:

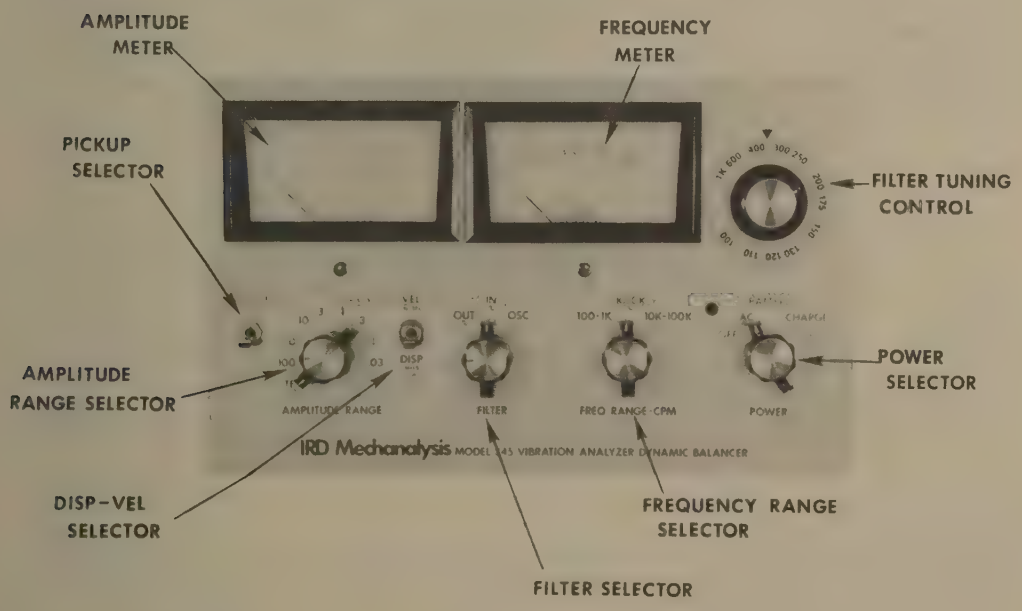


Figure 2-1 Front View of Model 345 Instrument

AMPLITUDE METER

The AMPLITUDE METER indicates peak-to-peak Displacement or peak Velocity of vibration. The meter has two scales, 0 to 1.0 and 0 to 3.0. The scale used to read the amplitude of the vibration is determined by the position of the AMPLITUDE RANGE SELECTOR.

FREQUENCY METER

The FREQUENCY METER indicates the vibration frequency in cycles per minute (CPM). The meter readings correspond to the FREQUENCY RANGE SELECTOR setting. When the FILTER SELECTOR is in the OUT position, the meter will indicate a strong predominant frequency value. If no strong predominant frequency exists, the meter will indicate a fluctuating reading. In both the IN and OSC (Oscillator) positions, the meter will read the frequency to which the filter is tuned. In TEST (⏦) the meter will read 3.6 KCPM ⏦ with 60 Hz power; 3.0 KCPM with 50 Hz power; or 24 KCPM with 400 Hz when the FREQUENCY RANGE SELECTOR is set to the 10k-100k range.

DISPLACEMENT-VELOCITY SELECTOR

Either the displacement or velocity of vibration can be chosen for measurement by the DISP-VEL SELECTOR. Displacement is measured in Mils peak-to-peak (1 Mil - 0.001 inch) and Velocity is measured in inches per second peak for instruments designed to measure in English units. Displacement is measured in Microns peak-to-peak and Velocity is measured in millimeters per second peak for instruments designed to measure in Metric units.

AMPLITUDE RANGE SELECTOR

The AMPLITUDE RANGE SELECTOR determines the full-scale meter range. Full-scale amplitude from 0.03 to 100 mils or inches per second (1.0 to 3000 microns or millimeters per second in Metric units) are covered in eight ranges as follows:

AMPLITUDE RANGE VALUES			
ENGLISH UNITS (Mils or In/Sec)		METRIC UNITS (Microns or MM/Sec)	
0 to 0.03	0 to 3.0	0 to 1.0	0 to 100
0 to 0.1	0 to 10.0	0 to 3.0	0 to 300
0 t0 0.3	0 to 30.0	0 to 10.0	0 to 1000
0 to 1.0	0 to 100	0 to 30.0	0 to 3000

The TEST position on the AMPLITUDE RANGE SELECTOR checks circuit operation (see "Circuit Operation Check" on Page 3-2).

FILTER SELECTOR

The FILTER SELECTOR determines the frequency response range of the instrument. In the OUT position no filtering of the vibration signal takes place, and the amplitude indicated on the meter is the overall vibration present in the range from 100 to 100,000 CPM.

To observe a single frequency component of the vibration signal, the FILTER SELECTOR is set to the IN position. The filter bandwidth is ± 2-1/2% of the tuned frequency.

To use the Model 345 as a strob-tachometer, the FILTER SELECTOR is set to OSC. This will energize an internal oscillator which will flash the stroboscopic light at a rate corresponding to the frequency set by the FREQUENCY RANGE SELECTOR and the FILTER TUNING CONTROL.

FREQUENCY RANGE SELECTOR

The filter or oscillator frequency range in cycles per minute (CPM) is determined by the FREQUENCY RANGE SELECTOR setting. Three ranges are provided: 100 to 1000 CPM, 1000 to 10,000 CPM, and 10,000 to 100,000 CPM.

FILTER TUNING CONTROL

The FILTER TUNING CONTROL indicates, at its FREQUENCY INDEX, the frequency to which the filter is tuned or the oscillator frequency. The control reads directly in CPM (cycles per minute) when the required multiplier is used, see table.

FILTER TUNING CONTROL MULTIPLIERS	
FREQUENCY RANGE SETTING	MULTIPLIER
100 to 1000	X 10
1K to 10K	X 100
10K to 100K	X 1000

NOTE: K = 1000, for example 10K = 10,000.

The FILTER TUNING CONTROL provides vernier control for both coarse and fine tuning. For coarse tuning, the control dial ratio is 6:1. When the tuning control is turned in the opposite direction the ratio is 36:1.

PICKUP SELECTOR

The PICKUP SELECTOR connects either the No. 1 or No. 2 vibration pickup signal to the analyzer.

POWER SELECTOR

The POWER SELECTOR disconnects all power from the analyzer circuits in the OFF position. In the AC position, the instru-

ment is turned on, power is obtained by connecting the Power Cord (see Figure 2-2) to an external 117-234-volt, 50/60/400 Hz supply.

CAUTION: Be sure the LINE VOLTAGE SELECTOR, a 2-position slide switch located on the bottom of the inside fold-down panel, is set to the position corresponding to the power-line voltage value (117 or 234 Volts). Otherwise, the 345 instrument could be severely damaged.

NOTE: Circuit operation of the Model 345 can be tested only when the POWER SELECTOR is set to AC.

In the BATTERY position the instrument is turned on, but the operating power is supplied by the internal batteries.

For operation in the CHARGE position see Chapter 5.0, and for the TEST position, see Page 3-3.

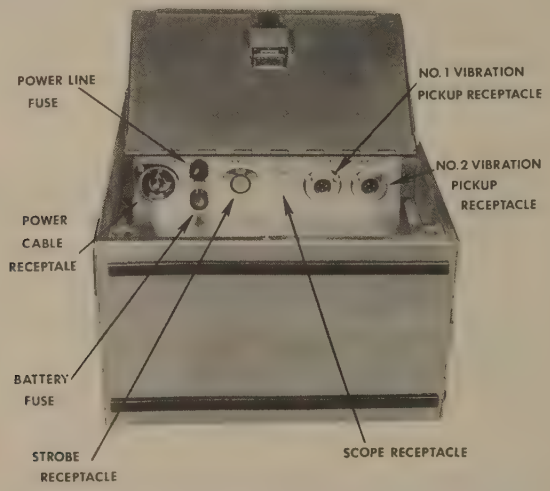


Figure 2-2 Cable Receptacle Panel

POWER CABLE RECEPTACLE

The POWER CABLE RECEPTACLE receives the twist-lock connector on the power cable which connects the instrument to a 117-234 volt 50/60/400 Hz ac power supply.

POWER LINE FUSE

The POWER LINE FUSE protects the analyzer power circuits when operated from the ac supply voltage. For 117 volt units, the fuse is rated at 1/2 ampere, type 3AG, slo-blo, Part No. 1511 - (for 234-volt units, 1/4 ampere, Part No. 5276).

NO. 1 VIBRATION PICKUP RECEPTACLE

The No. 1 VIBRATION PICKUP RECEPTACLE receives the connector on the pickup cable for the No. 1 Model 544 Vibration Pickup. Cannon connector No. XLR-3-11C is used with this receptacle.

NO. 2 VIBRATION PICKUP RECEPTACLE

The No. 2 VIBRATION PICKUP RECEPTACLE receives the connector on the pickup cable for the No. 2 Model 544 Vibration Pickup. Cannon connector No. XLR-3-11C is used with this receptacle.

NOTE: The pickup cable connectors are held in the receptacles by a spring lock. To release, press down on button on connector and pull out on connector.

STROB RECEPTACLE

The STROB RECEPTACLE receives the connector on the strob cable from the Model 569 Stroboscopic Light. Switchcraft connector No. A5M is used with this receptacle.

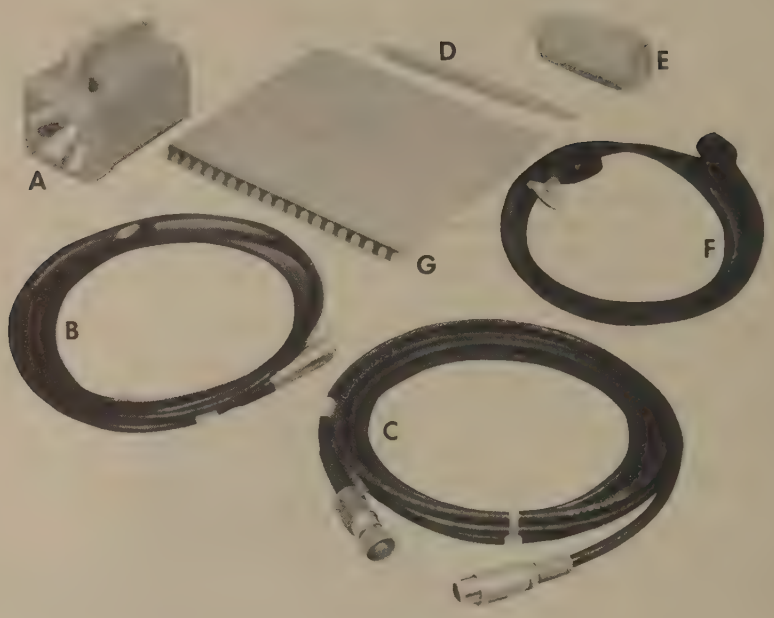
SCOPE RECEPTACLE

An ac vibration signal is available at the SCOPE RECEPTACLE for observation of either the filtered or unfiltered signal on an oscilliscope. For a full-scale meter deflection, the signal voltage is approximately 3-volts RMS. The signal line is at the center pin, and the case is grounded. When the VEL-DISP SELECTOR is in DISP position, the signal is proportional to the instantaneous vibration displacement. In the VEL position, the signal is proportional to the instantaneous vibration velocity.

NOTE: Amphenol connector type 31-002 (IRD Part No. 8408, not supplied) is used with this receptacle.

2.2 DESCRIPTION OF ACCESSORIES

2.2.1 STANDARD ACCESSORIES



A- Model 569 Strobe Light
B- 12-foot Strob Cable
C- 12-foot Pickup Cable
D- Straight Probe
E- Model 544 Vibration Pickup
F- 8-foot Power Cable
G- Instruction Manual

Figure 2-3 Model 345 Standard Accessories

MODEL 569 STROBOSCOPIC LIGHT

The Model 569 STROB LIGHT flashes at a rate equal to, or a sub-multiple of, the frequency of the measured vibration or the rate set on the FREQUENCY TUNING CONTROL when the FILTER SELECTOR is in the OSC position. The strob light is used to visually freeze (stop) the part of the machine causing the vibration. When used with the FILTER SELECTOR set to OSC, the flash rate is adjustable for slow-motion studies, strob-tachometer observations, and as an aid in tuning the filter plus indicating "phase" for balancing applications. The light has a 3-position switch: Forward is momentarily ON (spring loaded), Center is OFF, and Rear is on continuously.

12-FOOT STROB CABLE

The STROB CABLE connects the Model 569 STROB LIGHT to the 345 instrument. Belden cable No. 8424, one Female No. A5F, and one Male No. A5M Switchcraft connectors are used.

12-FOOT PICKUP CABLE

The PICKUP CABLE connects the Model 544 Vibration Pickup to either the No. 1 or No. 2 pickup input of the instrument. Belden cable No. 8428 is used with Cannon connector No. MS-3106E-10SL-4S, at pickup end, and Cannon quick-disconnect connector No. XLR-3-11C at instrument end.

IRD MODEL 544 VIBRATION PICKUP

The VIBRATION PICKUP senses machinery vibration and translates it into an electrical signal proportional to the velocity of the vibration. It can be used in any position without affecting sensitivity or accuracy. The pickup is sensitive to vibration only along its long axis and can be hand held against a machine or attached permanently using the 1/4-28 x 1/4 inch tapped hole. The pickup will withstand temperatures from -40° to +500°F (-40 to +260°C)

STRAIGHT PROBE

The STRAIGHT PROBE can be used to reach out of the way places. It attaches to the end of the VIBRATION PICKUP with the 1/4-28 x 1/4-inch stud. The probe should not be used for measuring vibration frequencies above 16,000 CPM

POWER CABLE WITH ADAPTER

The 8-foot POWER CABLE connects the 345 instrument to the 117-240-volt, 50/60 Hz power source. It is equipped with a 2-prong socket adapter.

INSTRUCTION MANUAL

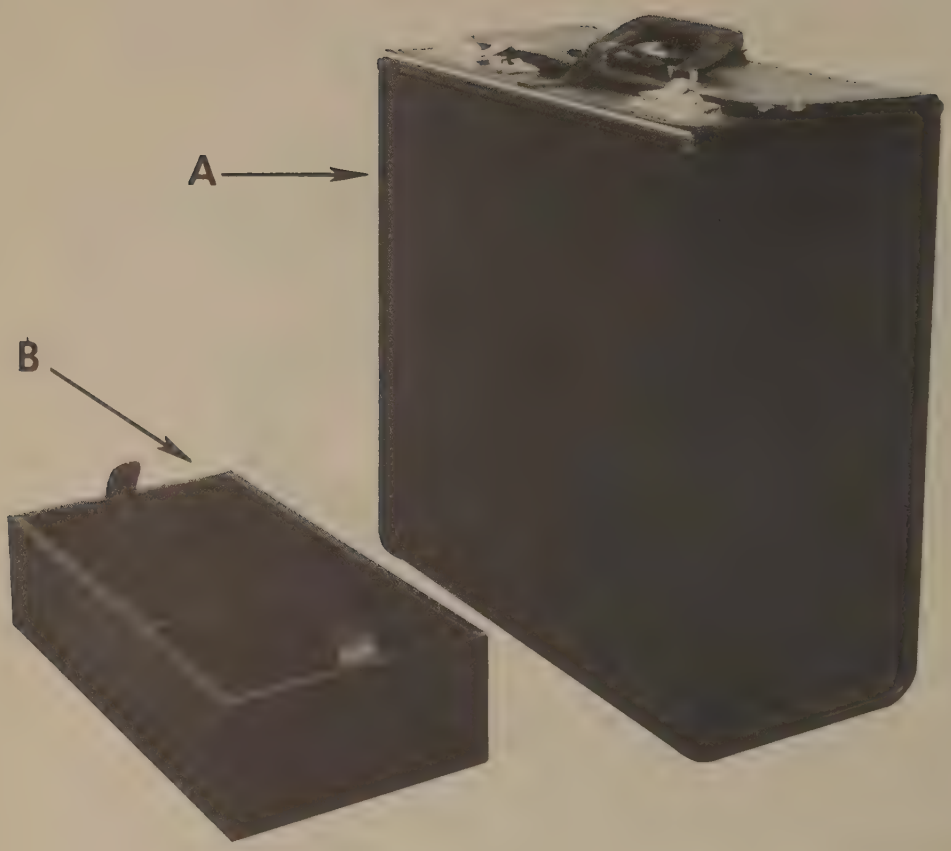
This INSTRUCTION MANUAL (Part No.12183) provides setup and operational information for Model 345 Analyzer. Additional copies of this manual are available from IRD Mechanalysis.

2.2.2 OPTIONAL ACCESSORIES

The OPTIONAL ACCESSORIES for the Model 345 instrument consist of Transit Case (Part No. 11940), Non-Contact Displacement Accessory (Two-Channel Part No. 9252) (Single Channel Part No. 9251), Magnetic Pickup Holder (Part No. 4332), and Vice Grip Plier Assembly for mounting pickup (Part No. 1821)

TRANSIT CASE

The TRANSIT CASE (see Figure 2-4) measurements are 7-1/2" x 15-1/2" x 15-1/2", it provides storage space for the Model 345 instrument and standard accessories. The case fits handily under an aircraft seat and can be locked with the key provided.



A-Transit Case B-Accessory Shelf
Figure 2-4 Model 345 Transit Case

TWO CHANNEL NON-CONTACT DISPLACEMENT ACCESSORY

The TWO CHANNEL ACCESSORY (Part No. 9252) can be used with two non-contact pickups to measure machine shaft position and shaft vibration simultaneously. The unit contains a meter for indicating the pickup gap. Supplied with unit are two non-contact pickups, two 30-foot pickup cables, and one 8-foot power cord.

ONE CHANNEL NON-CONTACT DISPLACEMENT ACCESSORY

The ONE-CHANNEL ACCESSORY (Part No. 9251) can be used with a non-contact pickup to measure the machine shaft position and the shaft vibration simultaneously. The unit contains a meter for calibrating the non-contact pickup gap. Supplied with unit is one non-contact pickup, one 30-foot pickup cable, and one 8-foot power cord.

2.3 SPECIFICATIONS

TABLE 2-1 SPECIFICATIONS OF MODEL 345
INSTRUMENT AND ACCESSORIES

ITEM	SPECIFICATION
Frequency Range	100 to 100,000 CPM.
Amplitude Range:	
English Unites	0.03, 0.1, 0.3, 1.0, 3.0, 10, 30, 100 mils peak-to-peak and in/sec peak.
Metric Units	1.0, 3.0, 10, 30, 100, 300, 1000, 3000 microns peak-to-peak, and mm/sec peak.
Tunable Filter Range	100 to 1000, 1000 to 10,000, and 10,000 to 100,000 CPM.
Filter Selectivity	Bandwidth, 5% max. of selected frequency at -3dB point, Q=20.
Filter Rejection	60 dB, ultimate rejection.
Filter Tuning Control	Dual ratio, 6 to 1 and 36 to 1.
Strob Oscillator Range	100 to 1000, 1000 to 10,000 and 10,000 to 1000,000 CPM.
Strob Light Output	One flash/cycle to 15,000 CPM; sub-multiple flash rate to 100,000 CPM.
Test Signal (∿)	Internal test signal checks circuits for proper operation.
Battery Test	Internal circuits provide battery voltage measurement on Amplitude meter.
Temperature Range	0° to +150°F (-18° to +65°C) on AC power. 0° to +120°F (-18° to +49°C) on battery power.

TABLE 2-1 SPECIFICATIONS OF MODEL 345
INSTRUMENT AND ACCESSORIES
(CONTINUED)

ITEM	SPECIFICATION
Power Requirements	105/129 or 210/258 volts, 50/60/400 Hz, 20W. and rechargeable built-in Ni-Cad battery, 4.8 volts, 12 hours operation without strob, 8 hours operation with intermittent strob. Recharge time, 14 hours.
Dimensions	Height 7-1/16", Width 11-1/8", Depth 14-1/16" (17.9 cm x 29.3 cm x 35.7 cm).
Weight	A. Complete with standard accessories, 20 lbs. (9.1 Kgm). B. Instrument without accessories, 14 lbs.(6.4 Kgm). C. Shipping weight, 35 lbs. (15.9 Kgm).
Standard Accessories	A. 1-Model 544 Vibration Pickup, Part No. 4526. B. 1-Straight Probe, Part No. 1103. C. 1-12 foot Pickup Cable, Part No. 4521. D. 1-Model 569 Strob Light, Part No. 8650. E. 1-12 foot Strob Light Cable, Part No. 8653. F. 1-8 foot Power Cable with Adapter, Part No. 2914.
Optional Accessories	A. Transit Case, Part No. 11940. B. Non-Contact Displacement Accessory, Single Channel, Part No. 9251. C. Non-Contact Displacement Accessory, Dual Channel, Part No. 9252.

TABLE 2-1 SPECIFICATIONS OF MODEL 345
INSTRUMENT AND ACCESSORIES
(CONTINUED)

ITEM	SPECIFICATION
Optional Accessories, Continued	D. Magnetic Pickup Holder, Part No. 4332. E. Vice-Grip Plier Assembly for Mounting Pickup, Part No. 1821.

TABLE 2-2 SPECIFICATIONS OF MODEL 544
VIBRATION PICKUP

ITEM	SPECIFICATION
Frequency Range	12 Hz to 1000 Hz ± 8%, -8% ± 13% @ 10 Hz.
Sensitivity	764 ± 10% MV RMS/in/sec (peak)
Temperature Range	-40°F to +500°F (-40° to 260°C)
Impedance	R=2000 Ohms, L=0.7 Hy.
Damping Factor	0.7 (critical)
Orientation	Any
Transverse Response	Less than 5% ave., between 10 Hz and 1000 Hz.
Magnetic Field Sensitivity	0.15 inches/sec/gauss
Housing	Weatherproof, dustproof
Connector	2-Pin, 732S-10SL-4P
Weight	21 oz. (0.6 Kg)
Grounding	Case and signal ground common

TABLE 2-2 SPECIFICATIONS OF MODEL 544
VIBRATION PICKUP (CONTINUED)

ITEM	SPECIFICATION
Mounting	1/4-28 x 1/4-inch tapped hole.
Maximum Amplitude	125 mils (3166 mm)

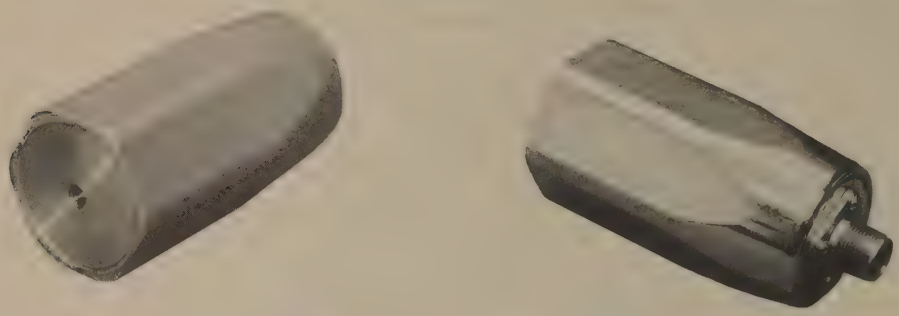


Figure 2-5 Model 544 Pickup

TABLE 2-3 SPECIFICATIONS OF SINGLE CHANNEL
NON-CONTACT DISPLACEMENT ACCESSORY

ITEM	SPECIFICATION
Channels	One, with four pickup inputs, selectable by pickup selector switch.
Meter	±20-mil scale to read mean gap. Zero center scale reads nominal 60-mil gap.
Displacement Output	One output, calibrated for 763 mv (RMS) for a 1-mil p-to-p displacement to be compatable with IRD Analyzers
DC Gap Output	One output, range 20 mils, DC output voltage variation, +4 to +8 volts (approx.) over the 20-mil range. Nominal gap size, 60 mils. Output voltage set to +6 volts.

TABLE 2-3 SPECIFICATIONS OF SINGLE CHANNEL NON-CONTACT DISPLACEMENT ACCESSORY (CONTINUED)

ITEM	SPECIFICATION
Operating Temperatures	Pickup and Cable, +32° to 250°F (0° to 121°C) Accessory, +32° to 150°F (0° to 66°C)
Power Requirements	117 or 234 volts, 50/60/400 Hz @ 25 Watts.
Dimensions	Approximate height: 4 in. (10.2 cm), length 6-1/2 in. (16.5 cm), and depth 7 in. (17.8 cm).
Weight	Approximate: 10 lbs.(4.5 Kgm)
Standard Accessories	One non-contact unshielded pickup, 60-mil nominal gap, Part No. 8248. One Pickup Cable, 30-foot, with connectors, Part No. 5347.

TABLE 2-4 SPECIFICATIONS OF TWO CHANNEL NON-CONTACT DISPLACEMENT ACCESSORY

ITEM	SPECIFICATION
Channels	Two separate output channels (A and B), permits Lissajous pattern presentation of dynamic signal. Four pickup inputs, two per channel, selectable by selector switch for each channel.
Meter	±20 mil (±0.5 mm) scale reads mean gap. Zero center scale reads nominal 60-mil (1.5 mm) gap.

TABLE 2-4 SPECIFICATIONS OF TWO CHANNEL
NON-CONTACT DISPLACEMENT ACCESSORY (CONTINUED)

ITEM	SPECIFICATION
Meter Selector Switch	Two position, selects channel A or B pickup mean gap for meter readout.
Displacement Output	Two separate outputs, Channel A and B. Each output calibrated for 763 mv RMS @ 100 Hz for a 1-mil p-to-p displacement to be compatible with IRD Analyzers. Each output displacement range 0 to 20 mil (0 to 5 mm) p-to-p. Frequency range, 150 to 500,000 CPM.
DC Gap Outputs	Two separate outputs for each channel (A & B) for calibration. Each output range ± 20 mils (±.5 mm). Each output DC voltage variation approx. +4 to +8 volts over ± 20 mil (±0.5 mm) range. Nominal gap of 60 mils (1.5 mm) output voltage set to +6 volts.
Operating Temperatures	Pickups and cables, +30° to +250°F (0° to +121°C) Accessory, +32° to 150°F (0° to 66°C)
Power Requirements	117 or 234 volts, 50/60/400 Hz @ approximately 25 watts.
Dimensions	Approximate: Height 4 in. (10.2 cm), Length 6-1/2 in. (16.5 cm), and Depth 7 in. (17.8 cm).
Weight	Approximate: 10 lbs. (4.5 Kg)

TABLE 2-4 SPECIFICATIONS OF TWO CHANNEL
NON-CONTACT DISPLACEMENT ACCESSORY (CONTINUED)

ITEM	SPECIFICATION
Standard Accessories	Two Non-Contact Unshielded Pickups, 60 mil nominal gap. Model 402, Part No. 8248. Two 30-foot Non-Contact Pick-up Cables with connectors. Part No. 5347. One 8-foot Power Cord. Part No. 2914.

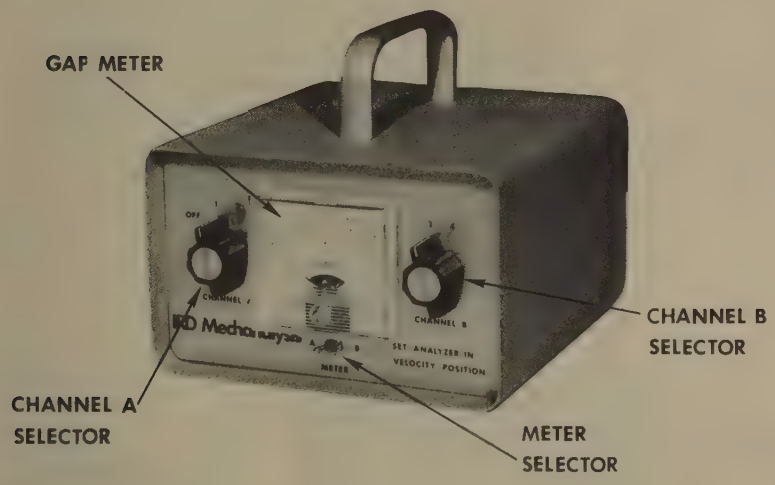


Figure 2-6 Two Channel Non-Contact Displacement Accessory

TABLE 2-5 SPECIFICATIONS OF NON-CONTACT
PICKUP, MODEL 402, PART NO. 8248

ITEM	SPECIFICATION
Gap Range	40 to 80 mils (1.0 to 2.0 mm)
Standard Calibration	SAE 4140 Steel

TABLE 2-5 SPECIFICATIONS OF NON-CONTACT PICKUP, MODEL 402 (CONTINUED)

ITEM	SPECIFICATION
Ambient Temperature Range	0° to +250°F (-17.7° to +121°C)
Isolation	Coil isolated from body.
Construction	Stainless steel body, insulated tip, teflon cable.
Environment	Pickup is waterproof and oil-tight. Waterproof connectors are available.

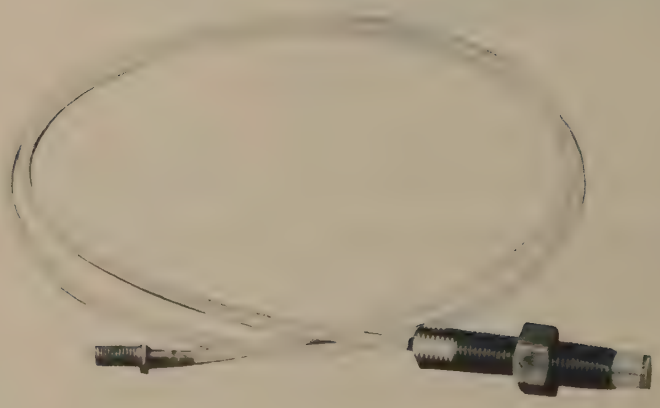


Figure 2-7 Model 402 Non-Contact Pickup

3.0 PREPARATION AND OPERATION

3.1 PREPARATION FOR OPERATION

To prepare the Model 345 Vibration Analyzer/Dynamic Balancer for operation, proceed as follows:

1. Connect the threaded end of the pickup cable to the 544 Pickup, and plug the other end into the pickup receptacle at the top rear of the 345 Analyzer (see Figure 3-1). A second Model 544 Pickup can be connected similarly. Set the "Pickup" selector to position 1 or 2 to connect the No. 1 or 2 pickup to the analyzer input.

2. Connect one end of the strob light cable to the Strob Light and the other end to the Strob Light Receptacle at the top rear of the analyzer.

For Power Line Operation

1. Connect the power cable to the 345 Power Cable receptacle (top rear of instrument, see Figure 3-1) and to a power outlet (117 or 234 volt, 50/60/400 Hz). If power outlet is for a two-prong receptacle, use the power-cable adapter provided and connect the green adapter wire to a proper electrical ground. Set the POWER SELECTOR to AC, (see Figure 3-2), and then allow one (1) minute for warmup.

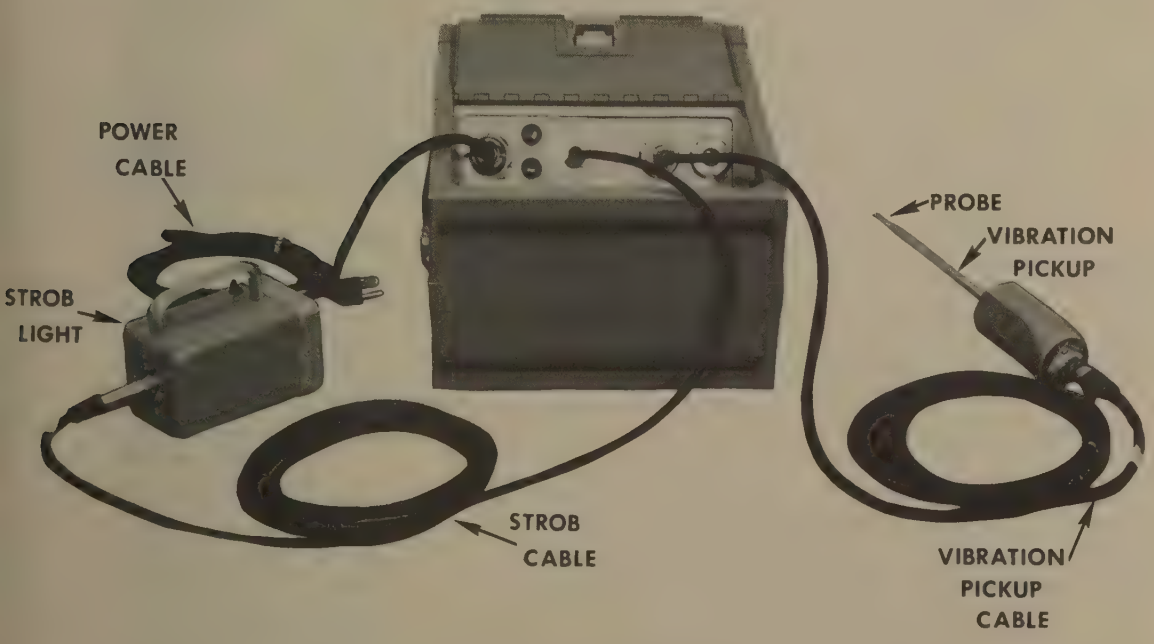


Figure 3-1 Model 345 Instrument With Interconnecting Cables Installed

2. Circuit Operation Checks: Set VEL-DISP SELECTOR to DISP (Displacement), and set the AMPLITUDE RANGE SELECTOR to TEST (see Figure 3-2).

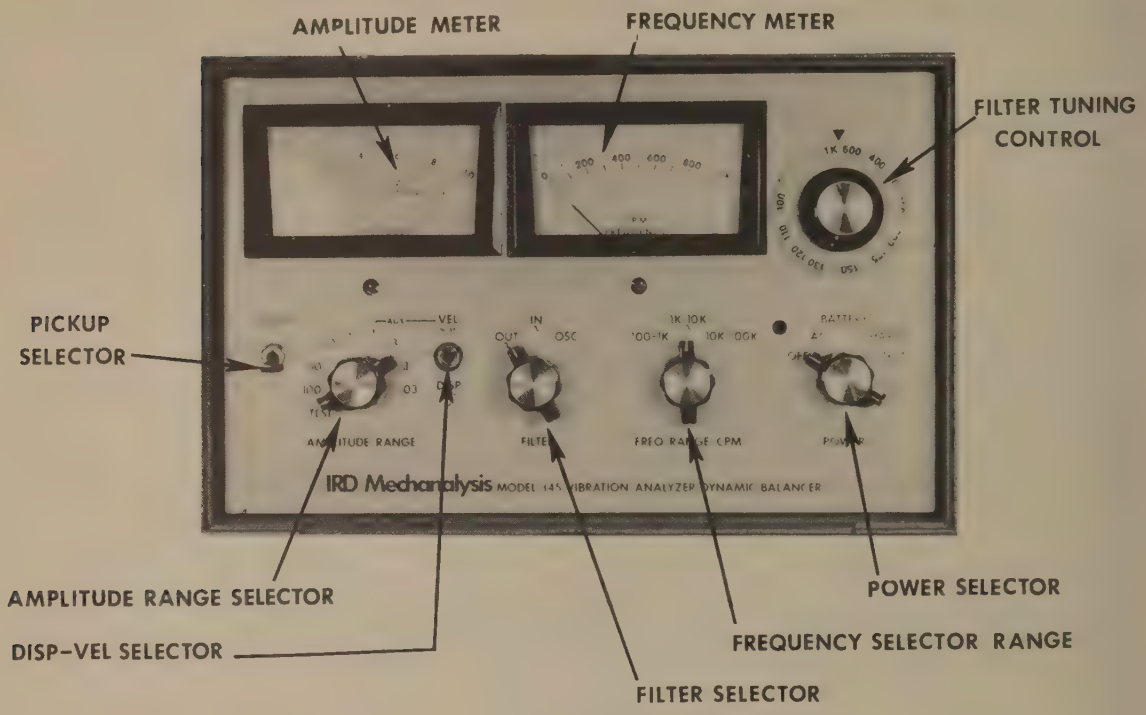


Figure 3-2 Model 345 Control Panel

A. Set the FILTER SELECTOR to OUT and the FREQ RANGE SELECTOR to 1K-10K, then check the 345 meter readings. An Amplitude Meter reading within the "Test Zone" ⌈∿⌉ indicates normal circuit operation.

NOTE: If the power line frequency rate used in Step A is not the Hz value for which the 345 is designed, the Amplitude Meter may not read within its "Test Zone". (For example, if designed for a 50 Hz supply voltage, but connected to a 60 Hz supply, the meter will read 20 percent high; if designed for a 60 Hz supply voltage, but connected to a 50 Hz supply, the meter will read 20 percent low; and if designed for a 50 or 60 Hz supply voltage, but connected to a 400 Hz supply, the meter will read approximately 85 percent low.)

B. With the selectors set as in A, check the Frequency meter reading. For 50 or 60 Hz line power, the meter should read within the "Test Zone", it should read 3000 CPM for 50 Hz and 3600 CPM for 60 Hz. For 400 Hz line power, set the FREQUENCY RANGE SELECTOR to the 10K-100K range, the Frequency meter should then read 24,000 CPM.

C. Set the FILTER SELECTOR to IN and repeat Steps A and B; however, the FILTER TUNING CONTROL should be adjusted in each step for a peak reading on the Amplitude Meter. The same meter readings as listed in Steps A and B should be obtained.

D. Set the FILTER SELECTOR to OSC and set the FREQ RANGE SELECTOR to 100-1K range. (The Stroboscopic Light control is a 3-position switch. It is turned OFF at the center position, and turned ON at either the forward or rear position. The switch is spring-loaded in the forward position, thus, it must be held in this position.) When the Strob Light switch is turned on, the strob lamp will flash at the rate indicated by the 345 TUNING SELECTOR and the FREQUENCY RANGE SELECTOR up to 15,000 CPM. Above 15,000 CPM, the lamp will flash at the sub-multiple of the indicated frequency (see flash rate values in Table 3-1).

TABLE 3-1 STROB FLASH RATE VALUES

SIGNAL FREQUENCY RANGE	STROB FLASH RATE
From 0 CPM to 1FS	One flash per revolution
From 1FS to 2FS	One flash each second revolution
From 2FS to 3FS	One flash each third revolution
From 3FS to 4FS	One flash each fourth revolution
From 4FS to 5FS	One flash each fifth revolution
From 5FS to 6FS	One flash each sixth revolution
From 6FS to 7FS	One flash each seventh revolution

Note: FS is CPM value of first strob scaling (15 KCPM $\pm$2.0%).

For Battery Operation

1. To check the battery voltage, set the POWER SELECTOR to TEST (see Figure 3-2). The AMPLITUDE METER indicates the battery condition on its LO [BATTERY] HI scale. If the meter indication is near HI, the battery is fully charged. If the meter reading is near or below LO, the battery requires recharging. To conserve battery energy, release the POWER SELECTOR immediately after the reading is obtained. See BATTERY CHARGING instructions in Chapter 5.0.

2. To operate the Strob Light on battery, set POWER SELECTOR to BATTERY, and check operation as instructed in Step 2D (Page 3-2) under Power Line Operation. To conserve battery power, use the spring return Strob Light switch position and avoid operating the light for long periods.

NOTE: When the Strob Light has been operated on battery power, recheck the battery voltage. If the voltage is LOW, recharge batteries.

High quality Nickle Cadmium batteries are used in the Model 345 which are capable of hundreds of charge-discharge cycles in normal operation. To obtain optimum performance and battery life, the batteries should be maintained in a fully charged condition. This requirement can be easily fulfilled by: (1) Recharging after each use of the analyzer in the BATTERY mode, and (2) Recharging once each month, even if the analyzer has not been used (the batteries will loose their charge over a non-recharged interval of several weeks).

CAUTION: To prevent accidental discharging of the batteries, the POWER selector should be set to OFF after each use of the analyzer in the BATTERY mode.

3.2 OPERATION, VIBRATION ANALYSIS

1. Prepare the Model 345 instrument for Operation as instructed in Section 3.1.

2. Set FILTER SELECTOR to OUT (see Figure 3-2).

3. Set the VEL-DISP SELECTOR to DISP, or VEL position. (The VEL position is often selected for vibration analysis.)

4. Mount vibration pickup on bearing housing of rotating equipment being analyzed.

5. Begin analysis with AMPLITUDE RANGE SELECTOR set to 100 (3000 for metric units), then reset AMPLITUDE RANGE SELECTOR cw until a reading of at least 1/3 full-scale is obtained on the Amplitude Meter. This reading is the overall vibration level where the vibration pickup is mounted (Step 4).

Two sets of graduations are provided on the Amplitude Meter scale. The top set is from 0 to 1.0, and the bottom set is from 0 to 3.0. The AMPLITUDE RANGE SELECTOR setting determines the graduations to use. For English units, use the 0 to 1.0 graduations for AMPLITUDE RANGE SELECTOR settings of 100, 10, 1, and 0.1; and use the 0 to 3 graduation for settings of 30, 3, 0.3, and 0.03. For Metric units, use the 0 to 3 graduation for AMPLITUDE RANGE SELECTOR settings of 3000, 300, 30, and 3.0; and use the 0 to 1.0 graduations for settings of 1K, 100, 10, and 1.0. Always place the decimal point in the meter reading to correspond with the AMPLITUDE RANGE SELECTOR setting.

6. Shine the Strob Light on various rotating parts of the equipment being analyzed.

7. The rotating part causing the predominent vibration will trigger the lamp in synchronization with its rotating speed, thus it will appear to be stopped under the strob light.

8. If no single predominant vibration is detected, the 345 filter can be tuned to the vibration occurring at each frequency in the same manner that a radio is tuned to individual stations.

   Normally, machinery vibration occurs at frequencies equal to 1, 2, 3, 4 and sometimes at higher multiples of the rotating speed of the part. Checking the speed values shown on the machine nameplate will help one determine the likely vibration frequencies. Either of two methods can be used to tune the filter, the Peak Method or the Strob Light Method.

PEAK METHOD

A. Set FILTER SELECTOR to IN position.

B. Set FREQUENCY RANGE SELECTOR to the range that includes the frequency equal to the machine rotating speed (for example, if the machine speed were 1800 RPM, the 1K-10K range should be used).

C. Set the FILTER TUNING CONTROL so the approximate frequency of the rotating speed is positioned under the INDEX. Then set the AMPLITUDE RANGE SELECTOR so the Amplitude Meter reads in the upper two-third zone of its scale.

D. Slowly adjust the FILTER TUNING CONTROL (vernier drive) to fine-tune the filter. If the Amplitude Meter reading decreases, turn the selector in the opposite direction. Set the FILTER TUNING CONTROL so the highest reading is obtained on the Amplitude Meter. Reset the AMPLITUDE RANGE SELECTOR as required to keep the meter reading in the upper two-thirds zone of the scale.

E. Read the vibration amplitude value indicated on the Amplitude Meter, and read the frequency value indicated on the Frequency Meter (meter reading will correspond to value to which FILTER TUNING CONTROL is set). Multiply Frequency Meter reading times the appropriate number shown in Table 3-2.

TABLE 3-2 FREQUENCY RANGE MULTIPLIERS

Frequency Range Used	Frequency Meter Multiplier
100-1K	X 1.0
1K-10K	X 10.0
10K-100K	X 100.0

F. The filter should be tuned to each vibration present to SCAN through the entire frequency range in the same manner a radio dial is tuned to search for unknown stations. Scan the filter slowly using the FILTER TUNING CONTROL vernier to allow the instrument time to react. Also, reset the AMPLITUDE RANGE SELECTOR to consistantly provide a reading in the upper two thirds zone on the Amplitude Meter.

STROB LIGHT METHOD

A. Set the FILTER SELECTOR to OSC (Oscillate).

B. Set the FREQUENCY RANGE SELECTOR to the range that includes the frequency equal to machine rotating speed.

C. Set the FILTER TUNING SELECTOR so the approximate machine rotating speed is positioned under the INDEX.

D. Direct the Strob Light to illuminate the rotating shaft. A reference mark on the rotating part (key-way or chalk mark) will appear to rotate slowly under the Strob Light.

E. Slowly, set the FILTER TUNING CONTROL (vernier drive) to adjust the flash rate until the reference mark is stopped "frozen". That is, the mark will appear to stand still in one position.

F. Set the FILTER SELECTOR to IN. The filter is automatically tuned to the frequency equal to rotating part speed.

9. Place the vibration pickup at each bearing housing of the machine, and obtain vibration values from each position. Record the vibrational data in a form similar to that shown in Figure 3-3 and retain for future reference.

10. From Figure 3-4 or 3-5, determine whether or not a given vibration is excessive and requires correction.

11. When the vibration has been measured and recorded (Figure 3-3), the next step is to determine the nature of the trouble causing the vibration. The chart in Figure 3-6 lists the vibration characteristics for a variety of machinery troubles. This chart can be used to identify the causes of the measured vibration.

IRD MECHANALYSIS, INC. **DATA SHEET** DATE _____

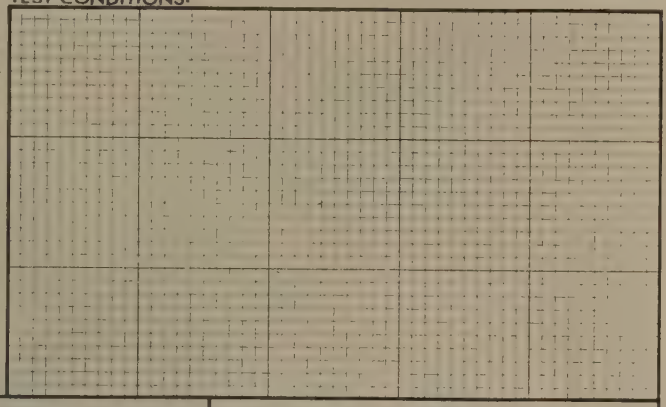
☐ NOISE ☐ VIBRATION ANALYSIS OF: _____

FOR: _____ TEST CONDITIONS:

MECHANALYSIS EQUIPMENT USED:

PERFORMED BY: _____

LEGEND:
→ PICKUP POINT
X PLAIN BEARING
⊠ ANTI-FRICTION BEARING
⊣⊢ COUPLING



PICKUP		FILTER OUT						FILTER IN					
		NOISE		DISPL.		VELOCITY							
POINT	POS.	dB(A)	CPM	MILS	CPM	IN/SEC	CPM						
	H												
	V												
	A												
	H												
	V												
	A												
	H												
	V												
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Figure 3-3 Vibration History Form

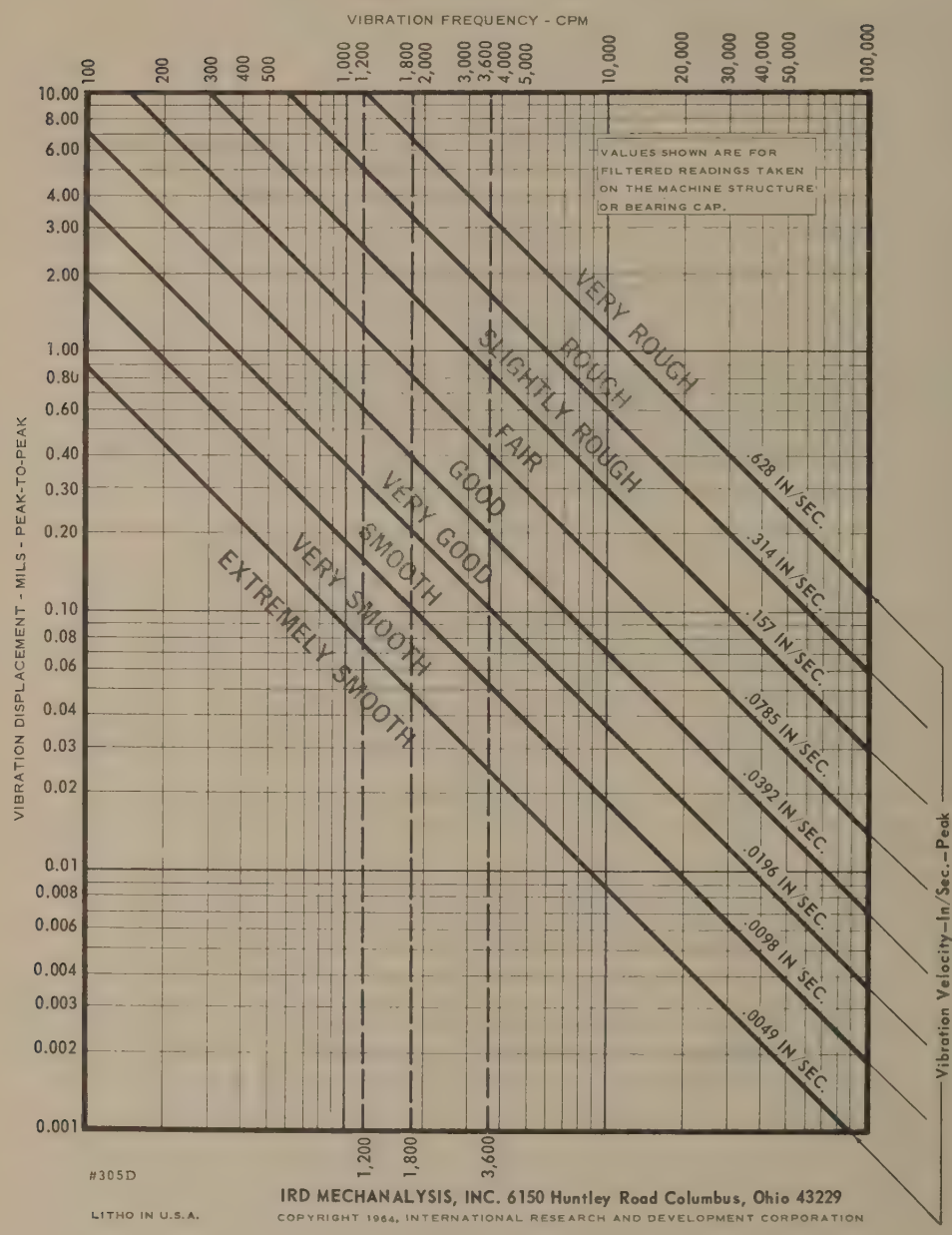

Figure 3-4 Vibration Severity Chart in Mils

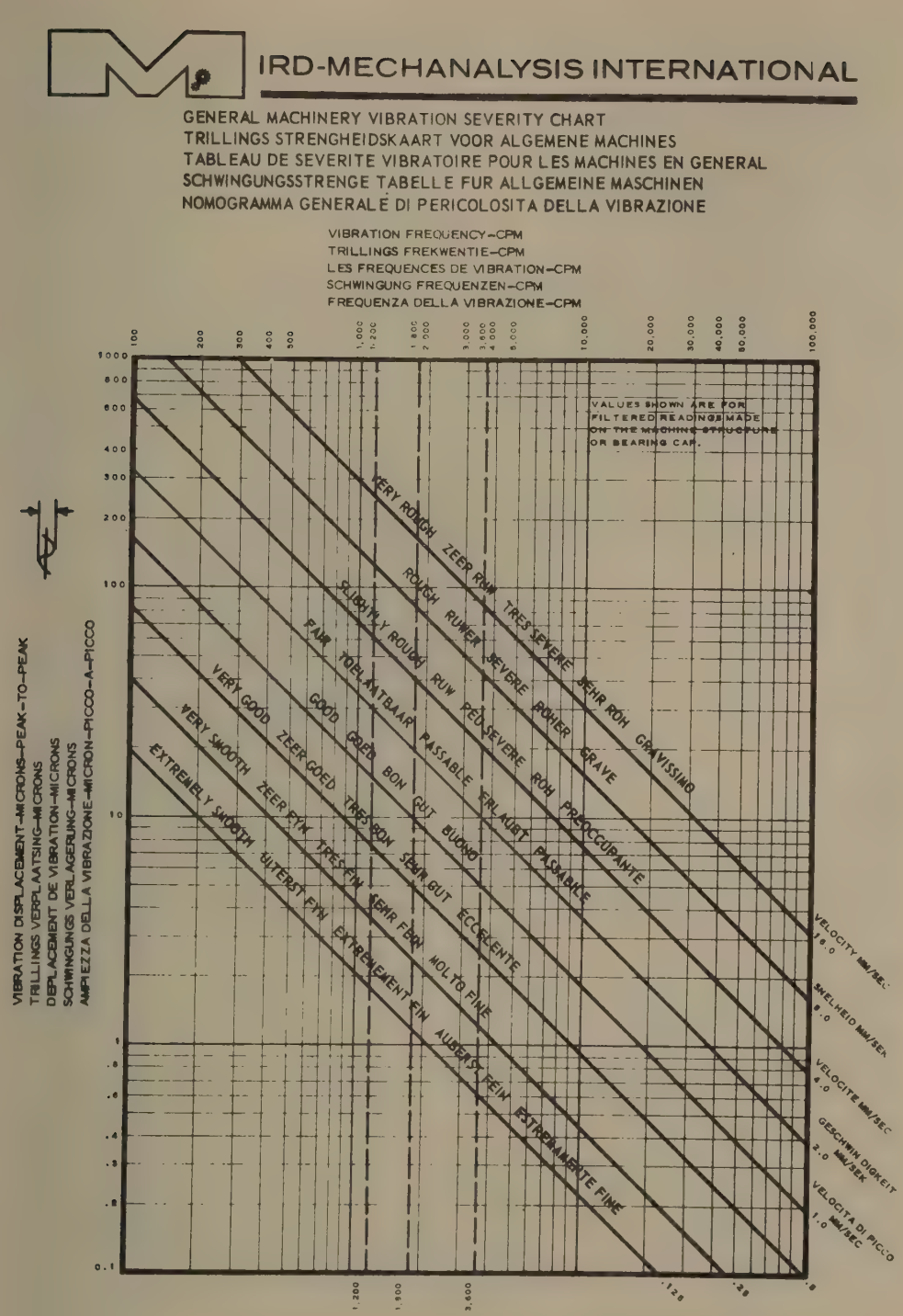
IRD-MECHANALYSIS INTERNATIONAL
GENERAL MACHINERY VIBRATION SEVERITY CHART
TRILLINGS STRENGHEIDSKAART VOOR ALGEMENE MACHINES
TABLEAU DE SEVERITE VIBRATOIRE POUR LES MACHINES EN GENERAL
SCHWINGUNGSSTRENGE TABELLE FUR ALLGEMEINE MASCHINEN
NOMOGRAMMA GENERALE DI PERICOLOSITA DELLA VIBRAZIONE
VIBRATION FREQUENCY-CPM
TRILLINGS FREKWENTIE-CPM
LES FREQUENCES DE VIBRATION-CPM
SCHWINGUNG FREQUENZEN-CPM
FREQUENZA DELLA VIBRAZIONE-CPM
VALUES SHOWN ARE FOR FILTERED READINGS MADE ON THE MACHINE STRUCTURE OR BEARING CAP.
VERY ROUGH ZEER RUW TRES SEVERE SEHR ROH GRAVISSIMO
ROUGH RUWER SEVERE POWER GRAVE
SLIGHTLY ROUGH RUW PEU SEVERE ROH PREOCCUPANTE
FAIR TOELAATBAAR PASSABLE ERLAUBT PASSABILE
GOOD GOED BON GUT BUONO
VERY GOOD ZEER GOED TRES BON SEHR GUT ECCELENTE
VERY SMOOTH ZEER FYN TRES FIN SEHR FEIN MOLTO FINE
EXTREMELY SMOOTH UITERST FYN EXTREMEMENT FIN AUSSERST FEIN ESTREMAMENTE FINE
VIBRATION DISPLACEMENT-MICRONS-PEAK-TO-PEAK
TRILLINGS VERPLAATSING-MICRONS
DEPLACEMENT DE VIBRATION-MICRONS
SCHWINGUNGS VERLAGERUNG-MICRONS
AMPIEZZA DELLA VIBRAZIONE-MICRON-PICCO-A-PICCO
VELOCITY MM/SEC
SNELHEID MM/SEK
VELOCITE MM/SEC
GESCHWIN DIGKEIT MM/SEK
VELOCITA DI PICCO MM/SEC

Figure 3-5 Vibration Severity Chart in Microns

VIBRATION IDENTIFICATION

CAUSE	AMPLITUDE	FREQUENCY	PHASE	REMARKS
Unbalance	Proportional to unbalance. Largest in radial direction.	1 x RPM	Single reference mark.	Most common cause of vibration.
Misalignment couplings or bearings and bent shaft	Large in axial direction 50% or more of radial vibration	1 x RPM usual 2 & 3 x RPM sometimes	Single double or triple	Best found by appearance of large axial vibration. Use dial indicators or other method for positive diagnosis. If sleeve bearing machine and no coupling misalignment balance the rotor.
Bad bearings anti-friction type	Unsteady - use velocity measurement if possible	Very high several times RPM	Erratic	Bearing responsible most likely the one nearest point of largest high-frequency vibration.
Eccentric journals	Usually not large	1 x RPM	Single mark	If on gears largest vibration in line with gear centers. If on motor or generator vibration disappears when power is turned off. If on pump or blower attempt to balance.
Bad gears or gear noise	Low - use velocity measure if possible	Very high gear teeth times RPM	Erratic	
Mechanical looseness		2 x RPM	Two reference marks. Slightly erratic.	Usually accompanied by unbalance and/or misalignment.
Bad drive belts	Erratic or pulsing	1, 2, 3 & 4 x RPM of belts	One or two depending on frequency. Usually unsteady.	Strob light best tool to freeze faulty belt.
Electrical	Disappears when power is turned off.	1 x RPM or 1 or 2 x synchronous frequency.	Single or rotating double mark.	If vibration amplitude drops off instantly when power is turned off cause is electrical.
Aerodynamic hydraulic forces		1 x RPM or number of blades on fan or impeller x RPM		Rare as a cause of trouble except in cases of resonance.
Reciprocating forces		1, 2 & higher orders x RPM		Inherent in reciprocating machines can only be reduced by design changes or isolation.

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Figure 3-6 Vibration Identification Chart

3.3 OPERATION, IN PLACE BALANCING

Unbalance is the most common cause of vibration in rotating machines. All vibration caused by unbalance can be detected very readily. This section explains one method for in-place balancing rotating machines. If this method is used, the rotating machine must be stopped and restarted approximately three times.

Mountings for installing balancing weights are provided on many rotating machines. The locations of the mountings is generally listed in the manufacturer's specifications. On some machines, various methods for installing balancing weights, such as by bolting or welding weights to the machines are used. On other machines, provisions are provided for removing existing weights from the machine. To perform In-Place Balancing proceed as follows:

1. Place a Phase Reference mark on the end of the machine shaft, from the center to one side of the shaft.

2. Mount the vibration pickup on or close to the machine bearing housing. Use the measuring direction (horizontal or vertical) having the highest vibration reading.

   Be sure the pickup is kept in the same position throughout the balancing operations.

NOTE: When balancing is required at two different points (such as at each end of the machine shaft), a pickup should be mounted at each balancing position.

3. Start the machine and allow it to come up to its normal operating speed.

4. Be sure the instrument Filter is tuned to the rotating speed as instructed in Step 8 in Section 3.2.

5. Visualize the rotating shaft as a clock face, and read the angular position of the reference mark as though it were a clock hand. Then, note the position of the reference mark (1:00, 2:00, etc.), also note the vibrational amplitude as read from the Amplitude meter for this position (see sample readings of 5:00 o'clock and 6.6 mils in Figure 3-7). In Figure 3-9 vector "O"is plotted from the values read from Figure 3-7.

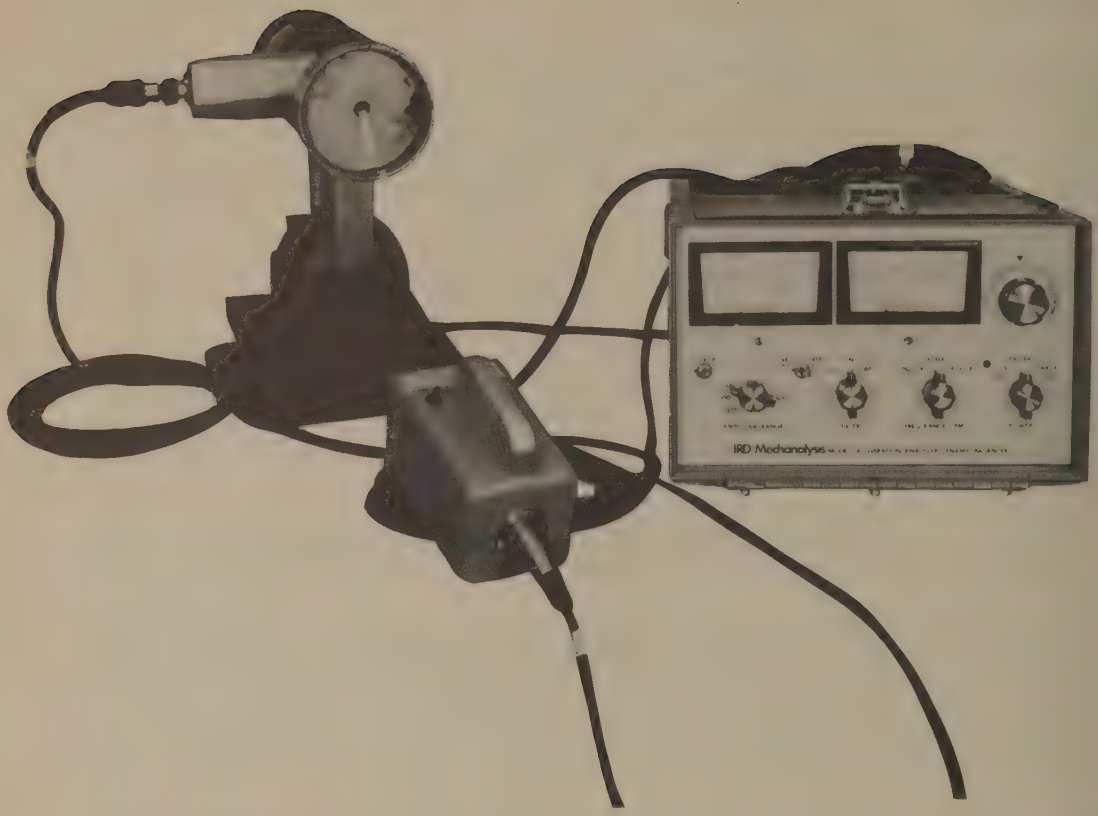


Figure 3-7 Original Unbalance Readings

6. Stop the machine, and install a trial weight on the rotor at any angular position. The amount of weight used, the installation angle, and the radius of the installation are not important. However, the same radius value must be used throughout the balancing.

WARNING: BE SURE ALL WEIGHTS ARE ATTACHED SECURELY.

7. Restart the machine and allow it to come up to its operating speed. Then be sure the Filter is tuned as instructed in Step 8 of Section 3.2.

8. Obtain and record a new vibration amplitude reading and note the new position of the reference mark (use strob light). In Figure 3-8 sample readings of 6.7 mils at 9:00 o'clock are shown. In Figure 3-9 these values are shown as vector O + T (original plus trial weight).

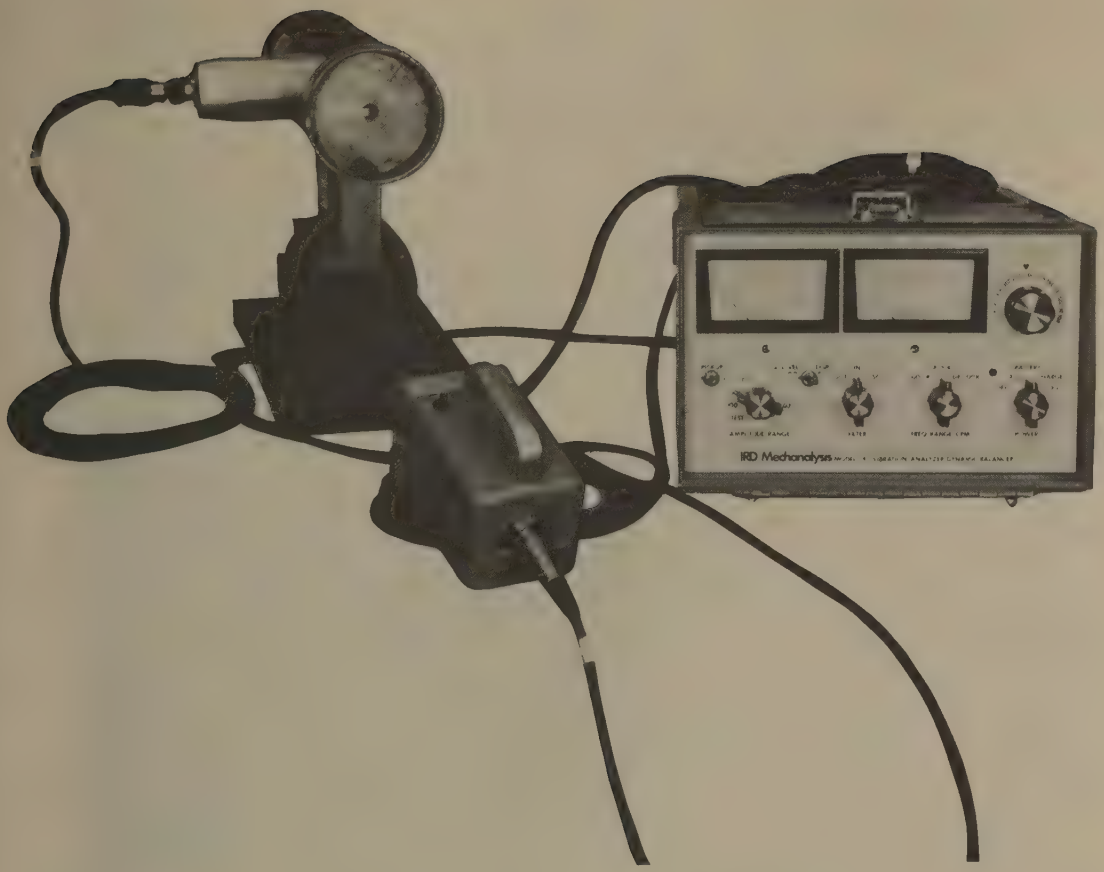


Figure 3-8 Unbalance Reading With Trial Weight Installed

9. Determine the exact amount of correction weight required, and the angular position for installing this weight as follows:

   A. By using the weight and angle values determined in Steps 5 and 7, construct a vector diagram on polar graph paper similar to the diagram illustrated in Figure 3-9. Draw vector "O" from the values noted in Step 5, and draw vector "O + T" from the values noted in Step 7. Then connect the ends of vectors "O" and "O+T" and label as line "T".

   B. By using a protractor, measure the angular distance between lines "O" and "T". Shift the trial weight by this angular distance in the opposite direction that the reference mark shifted. For example, in Figure 3-9, the angular distance between vectors "O" and "T" is 30°. And in Figure 3-8 the reference mark shifted from 5:00 o'clock (original position, Figure 3-7) to 9:00 o'clock. Since the reference

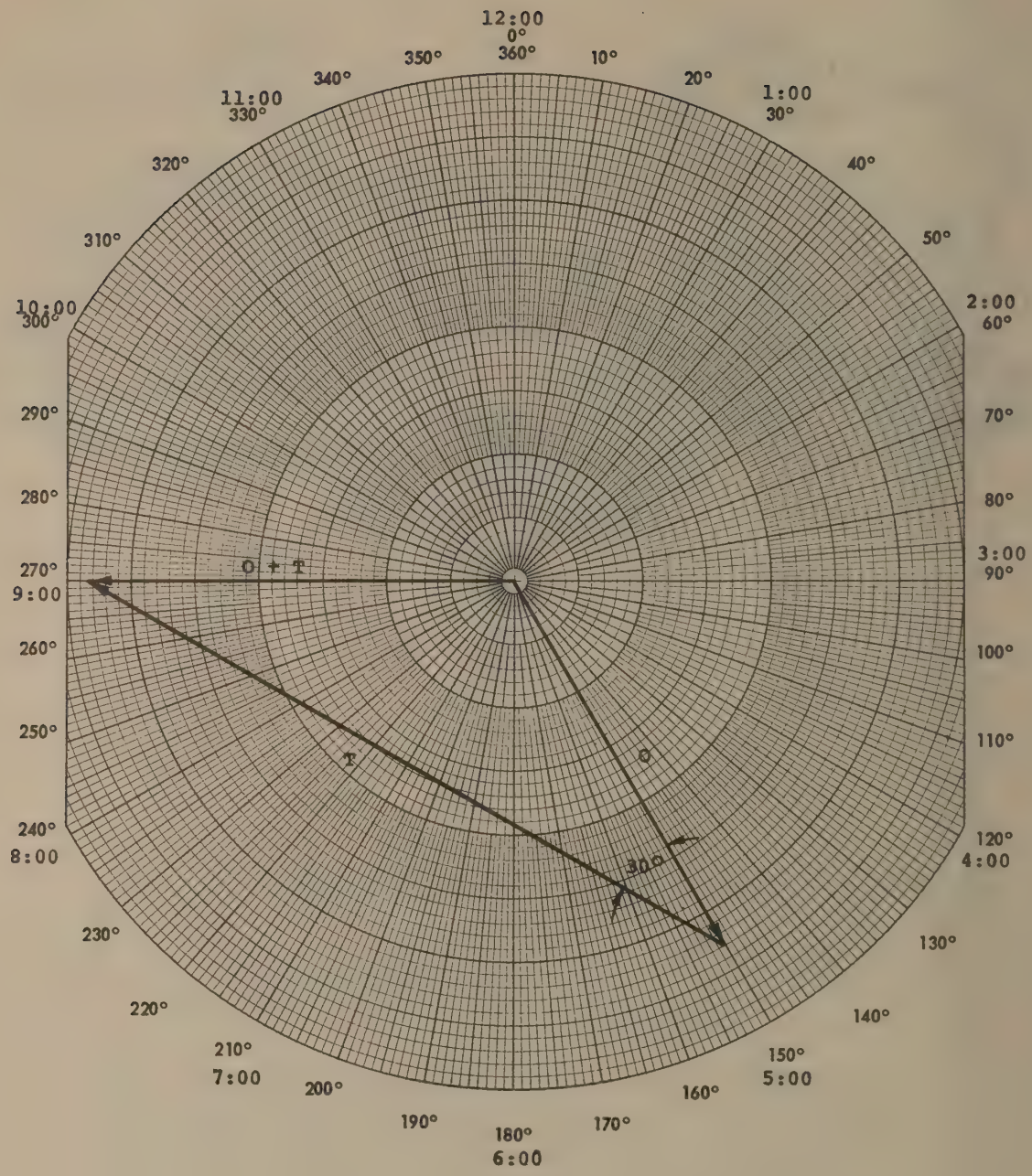


Figure 3-9 Sample Vector Diagram

mark shifted 30° clockwise, the trial weight must be moved 30° counter clockwise from its original position.

C. Calculate the amount of correction weight required by multiplying the ratio of vector "O" length to line "T" length times the trial weight value as shown below in Equation 3-1.

Equation 3-1:

$$\text{Correction Weight Value} = \frac{\text{Trial Weight Value}}{1} \frac{(O)}{(T)}$$

For example: in Figure 3-9 line "T" is 11.5 mils in length, and vector "O" length is 6.6 mils. If the Trial Weight were 5 ounces in weight, the required correction weight value would be calculated from Equation 3-1 as follows:

(1) $\text{Correction Wt. Value} = \frac{5 \text{ ounces}}{1} \frac{(6.6 \text{ mils})}{(11.5 \text{ mils})}$

(2) Correction Wt. Value = 2.87 Ounces

D. The vector diagram may not be 100% accurate, and the vector lengths may not correspond perfectly to the amplitude readings. Therefore, an additional trim run or so may be required for balancing to the desired tolerances. To perform an additional trim run, use the "O" vector determined in Step 5, and repeat the instructions presented in Steps 7 through 9 until the required tolerance values are obtained.

When making trim runs, always compare the new "O+T" value with the original "O" value.

NOTE: Successive trim runs can be made until the required balancing tolerances are met, or, if desired, until all of the unbalance is corrected. When performing an additional trim run, the unbalance remaining from the preceeding balancing run is to be plotted as the "O+T" vector for the trim run. This vector and the original "O" vector are to be interconnected. This line is to be used as the "T" vector for the trim run.

Detailed instructions and further information on balancing are available through the IRD Mechanalysis, Inc. Audio-Visual Training Programs. Information about these programs can be obtained by contacting the nearest IRD representative, or writing to IRD Mechanalysis, Inc., 6150 Huntley Road, Columbus, Ohio 43229.

4.0 CORRECTING MECHANICAL TROUBLE IN ROTATING MACHINE

This chapter explains how various vibrations are classified and corrected. It also discusses other applications for the Model 345 instrument. Instructions presented in Chapter 3.0 explained how to measure vibration, and how to correct vibration caused by unbalance.

4.1 CLASSIFYING AND CORRECTING EXCESSIVE VIBRATION

Any moving part in a rotating machine can cause vibration. Typical causes of excessive vibration are: misalignment of couplings or bearings, bent shafts, defective anti-friction bearings, eccentric journals, defective/noisy gears, mechanical looseness, defective drive belts, electrical interference, aero-dynamic hydraulic forces, and reciprocating forces. Each of these causes plus probable vibration amplitude values, frequency values, and suggestions for correcting the vibration are listed in the chart in Figure 3-6.

To apply information listed in Figure 3-6 for either classifying or correcting excessive vibration, the 345 instrument filter must be tuned to the vibrational frequency being studied (see Chapter 3.0, Section 3.2, Step 8), and the phase reference mark on the machine shaft must be accurately interpreted under the strob light. For example, if the rotating speed of the machine were 500 RPM and the vibration frequency being studied were 1500 CPM, three phase reference marks would be seen on the machine shaft as seen under the strob light when the filter is tuned to 1500 CPM.

Check the rotating machine for sources of vibration that are easily recognized, then concentrate on correcting the more difficult sources. Be sure the shaft couplings are properly aligned, and that the drive shafts are not bent. Also, be sure the machine is properly lubricated and that any defective drive belts are replaced.

5.0 SERVICE INFORMATION

This chapter contains only basic trouble-shooting and maintenance information for the Model 345 instrument. Generally, the operations required can be performed by the instrument operator. For complete service information on the Model 345 Vibration Analyzer/ Dynamic Balancer, contact IRD Mechanalysis, Inc., 6150 Huntley Road, Columbus, Ohio, 43229.

5.1 FIELD MAINTENANCE

Field Maintenance on the Model 345 instrument should be limited to performing the following operations which do not require the use of electronic test equipment:

A. Checking or Replacing Interconnecting Cables
B. Performing Built-in Circuit Tests
C. Replacing Power Fuses
D. Checking Instrument Preparation and Setup
E. Checking Battery Voltage
F. Recharging or Replacing Batteries

Checking Interconnecting Cables

Be sure the interconnecting cables are installed as shown in Figure 3-1 (Page 3-1). Also be sure all plug-in connectors are properly seated in the receptacles, and that all screw-in connectors are installed hand tight. Check suspected cables for intermittent connections by slight jiggling of the cable or by replacing the cable. All worn, damaged, or intermittent cables should be replaced (see part numbers in Specifications section. Page 2-10).

Performing Built-In Circuit Tests

Instructions for using the built-in 345 testing circuits are presented on Page 3-2, Steps 2A and 2B. The instrument circuits are operating properly when the 345 meters read as specified in these steps. If the desired overall operation is not obtained when the meters read properly in TEST, check the instrument setup and the external cabling carefully.

Replacing Power Fuses

Two fuses are used in the 345 instrument, and are located in the receptacle panel as shown in Figure 2-2. The Power Line fuse is 1/2-ampere (Part No. 1511) for 117-volt power, and 1/4-ampere (Part No. 5276) for 234-volt power. The

battery fuse is 5-amperes (Part No. 3849). Do not replace either fuse with a higher ampere fuse as the instrument could be severely damaged. If a replacement fuse blows when installed the instrument should be thoroughly serviced before using. See Section 5-2 for addresses of Service Depots.

Checking Instrument Preparation And Setup

Instructions for preparing and setting up the 345 instrument for operation are presented in Chapter 3.0, Pages 3-1 through 3-3. If the desired operation is not obtained, review these instructions and be sure the instrument is prepared and set up properly.

Checking Battery Voltage

Instructions for checking the internal battery voltage are presented on Page 3-3 under Battery Operation. If the required amplitude Meter reading is obtained in this check, the 345 instrument should operate satisfactorily in BATTERY. However, if the meter reading is very close to the LO point on the scale, the Strob Light might not flash when turned on. When the meter reads at the LO point recharge the batteries.

Recharging or Replacing Batteries

To recharge the 345 internal batteries, plug the power cord into the 117 or 234 volt AC supply and set the POWER SELECTOR to CHARGE. The batteries will be fully charged in approximately 14 hours. When the batteries are fully charged, in TEST the Amplitude Meter will read slightly above the HI point at the high end of the battery test zone.

If the batteries cannot be recharged, replace with new batteries (Part No. 12147) as follows:

a. Remove chassis from 345 cabinet by removing front and rear screw from each side of cabinet, and sliding out chassis.

b. Turn over chassis and remove the three visible screws from the hinged panel. Then swing hinged panel to open position.

c. Remove hold-down nut from battery cover and take off metal cover.

d. Disconnect both wire leads from battery (+ lead is red, and - lead is black).

e. Install replacement battery by performing Steps a. through d. in reverse order.

5.2 AUTHORIZED SERVICE DEPOTS

IRD Mechanalysis, Inc.
6150 Huntley Road
Columbus, Ohio 43229
Phone: 614/885-5376
Telex: 24-5318

IRD Mechanalysis, Inc.
Building C3
6001 Gulf Freeway
Houston, Texas 77023
Phone: 713/921-2145

Rise, Inc.
8282 Old Siegen Lane
Baton Rouge, Louisiana 70810
Phone: 504/766-4645

Industronics, Inc.
211 S. Ewing Avenue
Post Office Box 4102
Clearwater, Florida 33516
Phone: 813/446-2257

Comtel Laboratories
21186 Bridge Street
Southfield, Michigan 48037
Phone: 313/358-2500

Pivan Engineering
3535 W. Peterson Avenue
Chicago, Illinois 60659
Phone: 312/539-4838

IRD Mechanalysis, Inc.
3377 Mt. Diablo Blvd.
Suite 4
Lafayette, (San Francisco)
California 94549
Phone: 415/283-2065

Ataio Ingenieros S. A.
Enrique Larreta 12
Madrid 16, Spain
Phone: 733 05 62 733 37 00

Equipos Azucareros E.
Industries S.A.
Balderas 36 Despacho 1005
Mexico 1 D.F., Mexico
Phone: 905/585-2911

IRD Mechanalysis, Ltd.
333 Barton St., East
Stoney Creek, Ontario
L8E 2L1 Canada
Phone: 416/662-7577
Telex: 061-8453

Mechanalysis, Ltd.
Hale Rd. Industrial Estate
Widnes, Cheshire, Pickerings Road
United Kingdom WA8 8XW
Phone: 051/424-5175

IRD Mechanalysis S.A.
Avenue Du Pesage, 136
B1050 Brussels, Belgium
Phone: 02/640.00.61 or
02/640.03.77
Telex: 22856

IRD Mechanalysis, Inc.
221 South Chester Pike
Suite A2
Glenolden, Pennsulvania 19036
Phone: 215/461-7060

Omicron S.R.L.
Via Roncaglia 14
20146 Milano, Italy
Phone: 487359 - 430390

Vibration Consultants (Pty)
Ltd.
P.O. Box 23668
Joubert Park
Transvaal, South Africa
Phone: 725-5107

IRD Mechanalysis, Ltd.
524 17 Ave., S.W., Room 203
Calgary, Alberta, Canada T2S 0B2
Phone: 403/264-4130
Telex: 03-824680

5.3 ORDERING REPLACEMENT PARTS

To order replacement parts, contact either your local IRD Mechanalysis Service Depot or the IRD home office (Section 5.8). On your purchase order, specify the following information for each part:

1. Model and complete serial number of instrument.
2. IRD Mechanalysis Part No.
3. Name of part (for example, resistor, capacitor, diode, etc.).
4. Reference symbol (C1, R1, Q4, etc.).

To order a part not listed in this manual, provide a complete description of the part, and include its function and location.

5.4 OBTAINING SERVICE

Before returning the instrument for repair, obtain service and shipping instructions from either your local IRD Mechanalysis Service Depot or the IRD home office. Package the Model 345 instrument along with the vibration pickup(s), strob light, power cord, and interconnecting cables carefully inside a strong carton. Be sure each article is well padded. Information should also be included giving details as to the nature of the problem or service desired.

5.5 REPLACEMENT PARTS LISTINGS

Table 5-1, which follows, contains the spare parts listing recommended for one year operation.
Table 5-2, Pages 5-5 through 5-8, contains an overall parts listing for the Model 345 Analyzer and the major accessories. The REFERENCE NUMBERS and ITEM NUMBERS listed in this table are keyed to the callouts used in Figure 5-1 Page 5-9. These callouts are used to find the physical location of the components.

TABLE 5-1 RECOMMENDED SPARE PARTS FOR ONE YEAR OPERATION

DESCRIPTION OF PART	QUANTITY REQUIRED	PART NO.
Relay, SPDT, 3 Vdc	1	9142
Fuse, 1/2-Ampere (for 117 VAC operation)	6	1511
Fuse, 1/4-Ampere (for 234 VAC operation)	6	5276
Fuse, 5-Ampere (for Battery operation)	6	3849
Battery, 4.8 Volt	1	12147
Toggle Switch	1	12930
Vibration Pickup, Model 544	1	4526
Pickup Cable, 12-foot	1	4521
Power Cable, 12-foot	1	2914
Strob Light Cable, 12-foot	1	8653
Strob Lamp (for 569 Strob Light Assy.)	1	8461
Lamp, Red (LED)	1	12155

TABLE 5-2 REPLACEMENT PARTS LISTING

REF. NO.	DESCRIPTION	ITEM NO.	PART NO.
C1	Capacitor, 1 MF, 200V, 1%	40	5044
C2	Capacitor, 0.1 MF, 80V, 5%	72	9342
C3&5	Capacitor, 1 MF, 25V	39	5028
C4	Capacitor, 0.033 MF, 80V, 5%	71	9336
C6	Capacitor, 50 MF, 25V	3	1481
C7	Capacitor, 10 MF, 25V	37	5026
C8	Capacitor, 0.47 MF	77	9899
C9	Capacitor, 1 MF, 50V	80	11562
C11	Capacitor, 50 MF, 25V	3	1481
C12	Capacitor, 100 PF	20	3605
C13	Capacitor, 200 MF,3V	35	4954
C14&17	Capacitor, 1 MF, 50V	16	3501
C15	Capacitor, 0.1 MF, 50 V	17	3506
C16	Capacitor, 0.01 MF, 50V., 1%	118	12572
C18	Capacitor, 0.1 MF, 50V	17	3506
C19	Capacitor, 0.01 MF, 50V, 1%	118	12572
C20&21	Capacitor, 0.012 MF, 80V, 5%	70	9334
C22	Capacitor, 0.002 MF, 100V	27	4571
C23	Capacitor, 0.00082 MF, 200V	8	5192
C24&26	Capacitor, 0.001 MF,80V, 5%	74	9632
C25&27	Capacitor, 0.01 MF, 100V, 10%	28	4572
C28	Capacitor, 0.047 MF, 400V	2	1434
C30	Capacitor, 0.00082, MF, 200V	8	5192
C31	Capacitor, 0.001 MF, 80V, 5%	74	9632
C32&33	Capacitor, 0.1 MF, 80V	72	9342
C34	Capacitor, 0.01 MF, 100V, 10%	28	4572
C35	Capacitor, 500 MF, 32	18	3531
C37	Capacitor, 1000 MF, 50V	97	12193

NOTE: Components with * prefix used only in units with Prefix C in Serial No.

TABLE 5-2 CONTINUED

REF. NO.	DESCRIPTION	ITEM NO.	PART NO.
C39&41	Capacitor, 100 PF	20	3605
C40	Capacitor, 500 MF, 3V	18	3531
C42	Capacitor, 10 MF, 500 V	33	4686
C43	Capacitor, 25 MF, 25V	38	5027
C44	Capacitor, 10 MF, 25V	37	5026
C46	Capacitor, 47 MF, 35V	117	12528
C47	Capacitor, 220 MF, 10V	73	9627
C48	Capacitor, 47 MF, 35V	43	12528
C49	Capacitor, 0.001 MF, 80V	134	9632
C50	Capacitor, 0.001 MF, 1 KV, 20%	121	4573
C53	Capacitor, 1 MF, 50V	133	1473
CR1,2, 4,6,7, & 9	Semiconductor, 1N914A	44	5398
CR3	Semiconductor, 1N5227	48	5584
CR5&8	Semiconductor, 1N5231B	45	5399
CR10	Semiconductor, FW600	54	7834
CR11&13	Semiconductor, FW200	19	3565
CR12	Semiconductor, 1N4003	123	5948
CR14	Semiconductor, 1N5228B	100	13005
CR15	Semiconductor, FW600	54	7834
CR16&18	Semiconductor, 1N4003	123	5948
CR17	Semiconductor, 1N3279	50	4580
IC1	Semiconductor, 741CLU	75	9692
IC2&3	Semiconductor, LM234CN	98	12194
IC4	Semiconductor, CD4001AE	78	9923
IC5	Semiconductor, F34001BC	122	12783
K1	Relay, SPDT, 3 Vdc	65	9142
Q1&2	Transistor, 2N5088	29	13103
Q3&4	Semiconductor, 2N3391	34	4826
Q5	Semiconductor, 2N4187	31	4587
Q6&7	Semiconductor, D40D4	53	7832
Q8	Semiconductor, 7824UC	99	12195
Q9	Semiconductor, 78L05AWC	101	12197
Q10	Semiconductor, 2N3391	34	4826
Q11&12	Semiconductor, 2N3611	30	4584
R1&2	Potentiometer, 2K	92	12185
R3	Potentiometer, 200K	96	12189
*R5	Potentiometer, 1 Megohm	95	13877
*R6&7	Potentiometer, 100K	94	13876
R8	Potentiometer, 5K	93	12796
R10	Resistor, 68.1K,1/8W, 1%	63	7867
R11	Resistor, 21.5K,1/8W, 1%	62	7862
R12	Resistor, 6.81K, 1/8W, 1%	60	7857
R13	Resistor, 2.15K, 1/8W, 1%	59	7851
R14	Resistor, 681 Ohms, 1/8W, 1%	58	7846
R15	Resistor, 215 Ohms, 1/8W, 1%	57	7844

TABLE 5-2 CONTINUED

REF. NO.	DESCRIPTION	ITEM NO.	PART NO.
R16	Resistor, 68.1 Ohms, 1/8W, 1%	56	7842
R17	Resistor, 31.6 Ohms, 1/8W, 1%	55	7841
R18	Resistor, 2.2 Megohm, 1/4W, 5%	76	9874
R19&21	Resistor, 100K, 1/4W, 5%	109	12206
R20	Resistor, 10K, 1/8W, 1%	61	7859
R22	Resistor, 270 Ohms, 1/4W, 5%	13	5378
R23	Resistor, 2.2 Megohm, 1/4W, 5%	76	9874
R24	Resistor, 27K, 1/4W, 5%	107	12204
R25	Resistor, 1 Megohm, 1/4W, 5%	42	5388
R26	Resistor, 10K, 1/4W, 5%	25	5383
R27	Resistor, 390K, 1/4W, 5%	111	12208
R28	Resistor, 221K, 1/8W, 1%	108	9282
R29	Resistor, 240K, 1/4W, 5%	110	12207
R30	Resistor, 27K, 1/4W, 5%	107	12204
R31	Resistor, 100K, 1/4W, 5%	109	12206
*R32			
&34	Resistor, 470K, 1/4W, 5%	41	5387
R33	Resistor, 10K, 1/4W, 5%	25	5383
R35	Resistor, 1.5 Megohms, 1/4W, 5%	112	12241
R36	Resistor, 27K, 1/4W, 5%	107	12204
R37	Resistor, 1 Megohm, 1/4W, 5%	42	5388
R38	Resistor, 10K, 1/4W, 5%	25	5383
R39	Resistor, 6.8K, 1/4W, 5%	22	5382
R40&41	Resistor, 10K, 1/4W, 5%	25	5383
R42	Resistor, 1K, 1/4W, 5%	21	5380
R43	Resistor, 22K, 1/4W, 5%	51	5995
R44	Resistor, 180 ohms, 1/4W, 5%	47	5489
R45	Resistor, 7.15K, 1/8W, 1%	69	9297
R46	Resistor, 1 Megohm, 1/4W, 5%	42	5388
R47,48			
&49	Resistor, 10K, 1/8W, 1%	61	7859
*R50			
&52	Resistor, 6.04K, 1/8W, 1%	119	8439
R51	Resistor, 392K, 1/8W, 1%	81	12148
R53&54	Resistor, 6.8K, 1/4W, 5%	22	5382
R55	Resistor, 1K, 1/4W, 5%	21	5380
R56	Resistor, 1.58K, 1/8W, 1%	104	10361
R57	Resistor, 22.1K, 1/8W, 1%	120	7863
R58	Resistor, 221 Ohms, 1/8W, 1%	12	8104
R59	Resistor, 910 Ohms, 1/4W, 5%	15	5379
R60&61	Resistor, 10K, 1/4W, 5%	25	5383
R62	Resistor, 22K, 1/4W, 5%	49	5883
R63	Resistor, 1.5K, 1/4W, 5%	103	12199
R64&65	Resistor, 150K, 1/4W, 5%	32	5386
R66	Resistor, 2.7K, 1/4W, 5%	106	12202
*R67	Resistor, 47K, 1/4W, 5%	79	10051
R68	Resistor, 332K, 1/8W, 1%	126	7870
R69	Resistor, 1 Magohm, 1/4W, 5%	42	5388

TABLE 5-2 CONTINUED

REF. NO.	DESCRIPTION	ITEM NO.	PART NO.
*R70	Resistor, 4.7K, 1/4W, 5%	46	4585
R71	Resistor, 1K, 1/4W, 5%	21	5380
R72	Resistor, 10K, 1/4W, 5%	25	5383
R74	Resistor, 220K, HW, 5%	5	1609
R75	Resistor, 180K, HW, 5%	4	1608
*R76	Resistor, 47K, 1/4W, 5%	79	10051
R77	Resistor, 1.2K, H.W. 5%	114	12243
*R78			
&79	Resistor, 47K, 1/4W, 5%	79	10051
*R80			
&81	Resistor, 4.7, 1/4W, 5%	46	4585
R82	Resistor, 5.491K, 1/8W, 1%	14	9862
R83	Resistor, 1.8K, 1/4W, 5%	105	12201
R85	Resistor, 150 Ohms, 1.5W	113	7880
R86	Resistor, 4.7 Ohms, 5W	116	12245
R87	Resistor, 270 Ohms, 1/4W, 5%	13	5378
R88	Resistor, 68 Ohms, 1/4W, 5%	102	12198
R89	Resistor, 1.3K, 1/4W, 5%	64	8634
R90	Resistor, 1K, 1/4W, 5%	21	5380
R91	Resistor, 47 Ohm, HW, 5%	23	4337
R92	Resistor, 1 Megohm, HW, 5%	6	1614
R93	Resistor, 270 Ohm, 1/4 W, 5%	13	5378
R94&95	Resistor, 100K, 1/4W, 5%	109	12206
R96	Resistor, 10K, 1/4W, 5%	25	5383
R97	Resistor, 150 K, 1/4W, 5%	32	5386
R99	Resistor, 3K, 1/4W, 5%	116	12245
R100	Resistor, 100K, 1/4W, 5%	109	12206
R101	Resistor, 27K, 1/4W, 5%	107	12204
R102	Potentiometer, 200K	96	12189
R104	Resistor, 47.5K, 1/8W, 1%	131	7866
R105	Resistor, 10K, 1/8W, 1%	132	7859
---	Resistor, 15 Ohm, 5W	---	5117
---	Resistor, 7.5K, 10W, 10%	---	5118
S1	Switch, Rotary, Amplitude Range	82	12149
S2	Switch, Rotary, Filter, IN, OUT,OSC.	83	12150
S3	Switch, Rotary, Frequency Range	84	12151
S4	Switch, Rotary, AC-BATTERY CHG.	85	12152
---	Switch, VEL-DISP	---	12930
---	Switch, Slide	---	12678
---	Knob, for S1, S2, and S3	---	7909
---	Knob, for S4	---	12076
---	Filter Dial, Screened	---	12730
---	Knob, for filter control	---	13104
---	Battery, 4.8 Volts	---	12147
---	Transformer, Power	---	12159
---	Transformer, 4.8 To 24V	87	12158
T3	Transformer, Converter	88	12160

TABLE 5-2 CONTINUED

REF. NO.		ITEM NO.	PART NO.
---	Lamp, Red (LED)	86	12154
---	Meter, Amplitude	---	12155
---	Meter, Frequency	---	12157
---	Fuse, 1/2-Ampere (117 V units only)	---	1511
---	Fuse, 1/4-Ampere (234 V units only)	---	5276
---	Fuse, Battery Supply, 5-Amperes	---	3849
---	Vibration Pickup, Model 544	---	5426
---	Vibration Pickup, Cable, 12 feet	---	4521
---	Transit Case for 345 Instrument	---	11904
---	Power Cable, 8 feet, with Adapter	---	2914
---	Strob Light, Model 569	---	8650
---	Strob Light Cable, 12 feet	---	8653
---	Strob Lamp	---	8461

NOTE: Components with * prefix used only in units with C in Serial No.

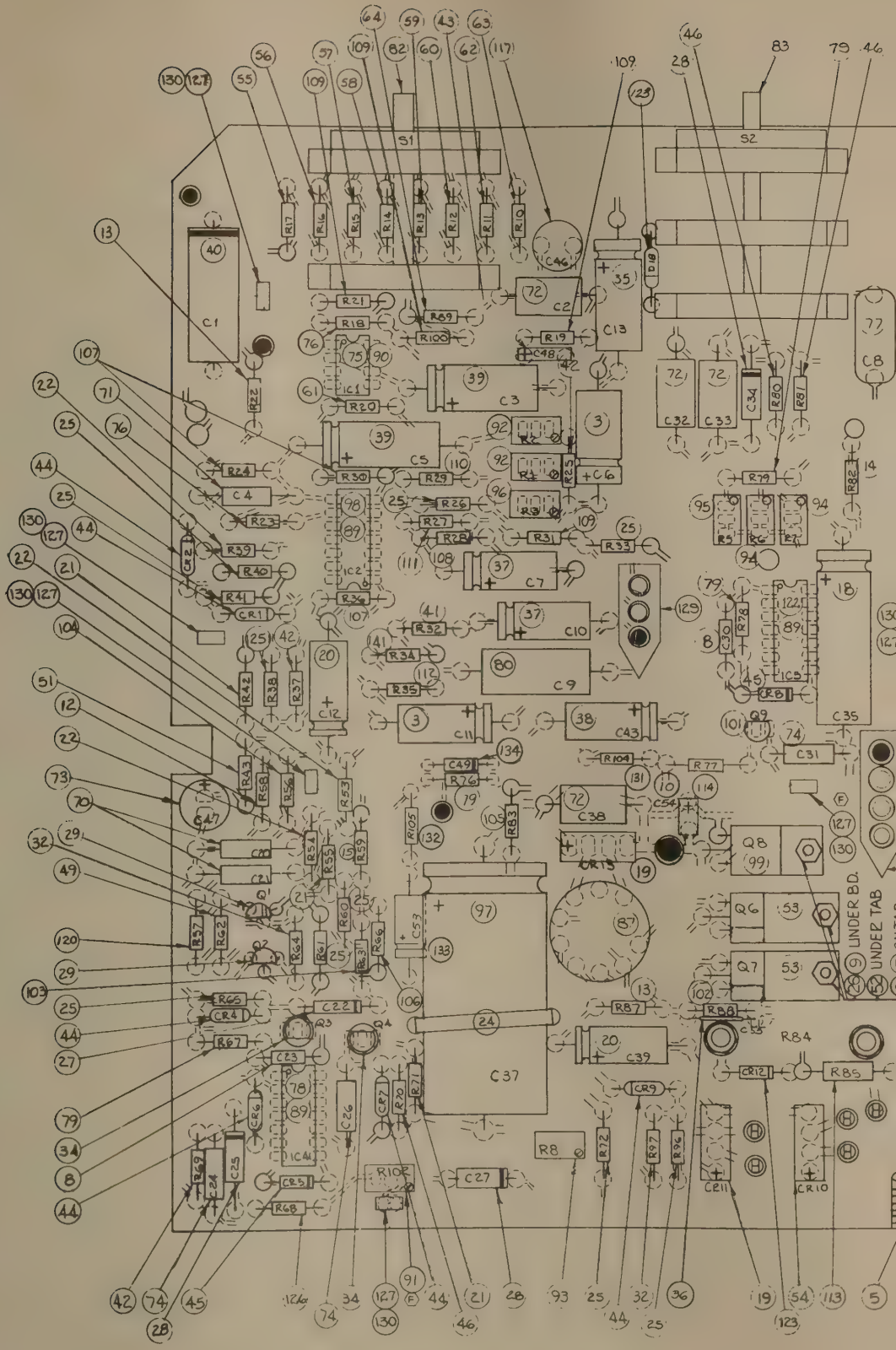
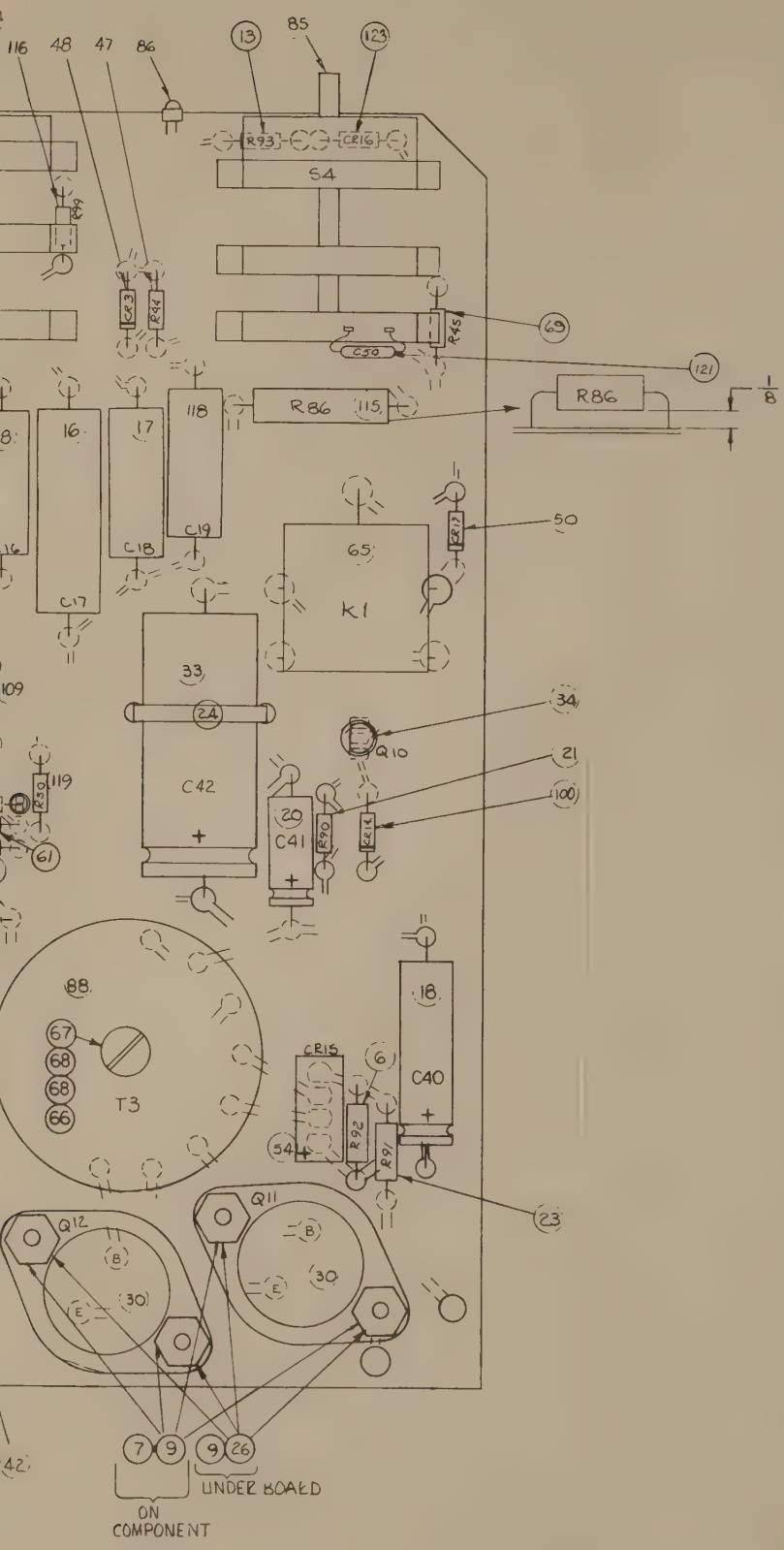


Figure 5-1 Model 345 Component Locations


116
48
47
86
13
85
123
R93
CR16
S4
R89
CR13
R44
R45
69
C50
121
R86
115
R86
1/8
118
16
17
C19
C18
C17
50
CR17
65
K1
33
24
109
34
Q10
21
100
C42
119
R88
61
20
C41
R90
CR14
88
67
68
68
66
T3
CR15
6
18
C40
54
R92
R91
23
Q11
Q12
B
E
30
B
E
30
7
9
9
26
UNDER BOARD
ON
COMPONENT
42

APPENDIX A
--Supplementary Service Information--

This Appendix consists of the Circuit Description and Operation, Calibration Procedure, and Trouble Shooting Guide for the Model 345 Vibration Analyzer. A replacement parts listing and illustration for location of these components are included in Chapter 5 of this Instruction Manual.

A.1 CIRCUIT DESCRIPTION AND OPERATION

A simplified block diagram of the analyzer circuits is shown in Figure A-1, and an overall electrical schematic of these circuits is shown in Figure A-12. The basic operation of the analyzer circuits is explained in Sections A.1.1 through A.1.8. A functional schematic of the circuits being discussed is included in each of these sections.

As shown in Figure A-1, the input vibration signal voltage is connected to the analyzer from the desired vibration pickup. When the Amplitude Range control is properly set, an upscale indication of the vibration level will be provided on the Amplitude Meter. The vibration amplitude can be displayed in either velocity or displacement by setting the selector switch on the front panel to the desired position.

The composite vibration signal voltage is connected to the analyzer. In the FILTER OUT mode-of-operation, the level of the overall vibration will be indicated on the Amplitude Meter. The output voltage of the Filter-Out Amplifier circuits are connected to the Amplitude Meter circuits. These circuits amplify the signal voltage to three times the original value, and provide two output voltages: an ac signal voltage to the Squaring circuits, and a dc signal voltage/current to the Amplitude Meter.

The Squaring circuits generate a rectangular voltage pulse at the predominate frequency of the vibration, for connection to the Strob Scaling and the Frequency Meter circuits. The Strob Scaling circuits generate a rectangular voltage pulse at the predominate vibration frequency, or at a scaled down frequency, for flashing the external strob light. The Frequency Meter circuits generate a rectangular pulse voltage at the predominant vibration frequency for operating the Frequency Meter.

In the FILTER IN mode-of-operation, the output signal voltage of the Signal Conditioner circuits is connected to the Filter circuits. These circuits supply a stable sinusoidal voltage at the vibrational frequency to which the TUNING DIAL of the analyzer is set. The amplitude of this voltage is proportional to the vibration level at the tuned frequency. The output voltage of the Filter circuits is further processed by the Amplitude Meter, Squaring, Strob Scaling, and Frequency Meter circuits in the same manner described above for the FILTER IN

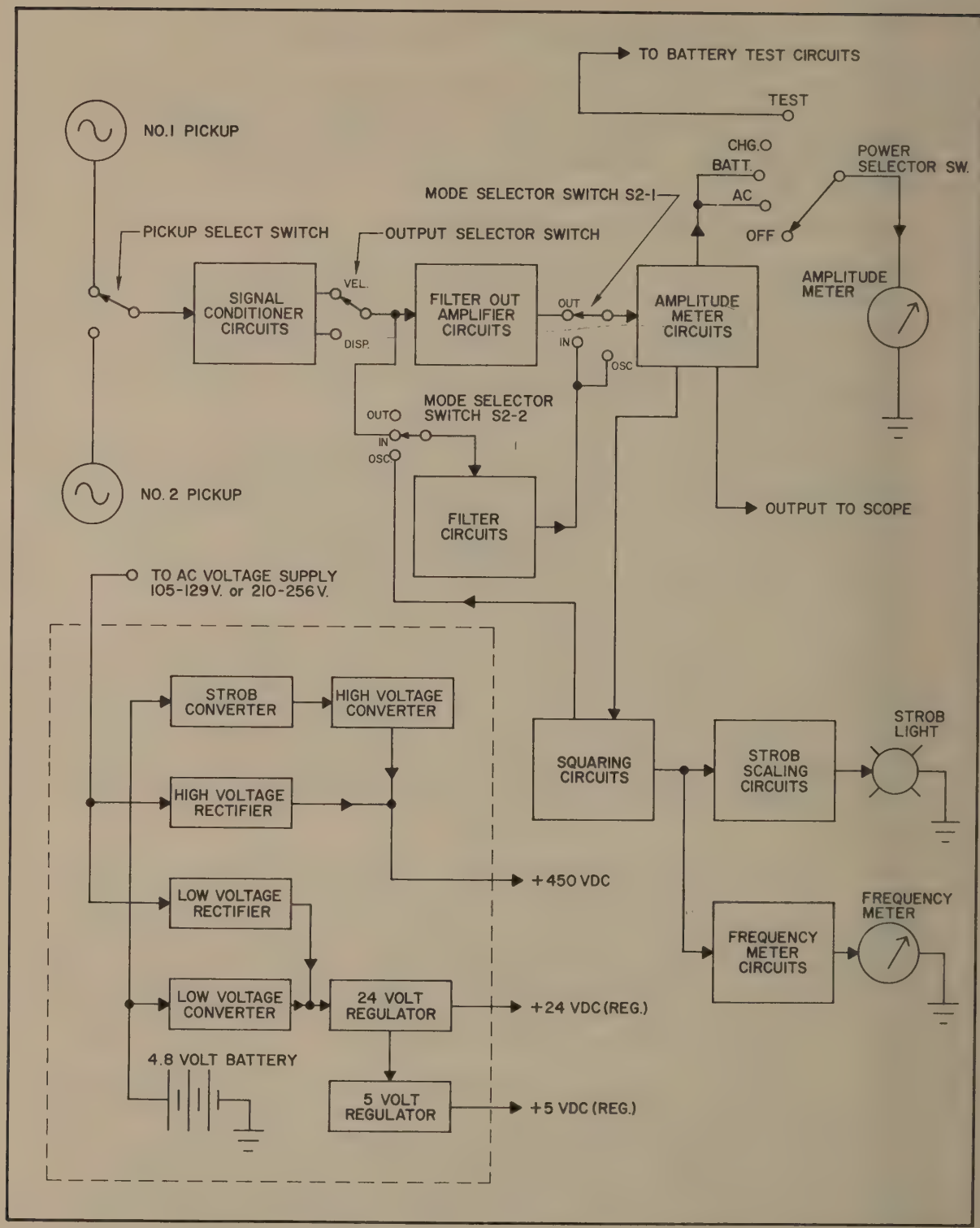


Figure A-1 Simplified Block Diagram of Model 345 Circuits

mode. However, in the FILTER IN mode, only the vibration signal voltage at the tuned frequency will be processed.

In the Oscillator (OSC) mode-of-operation, the vibration signal voltage will be disconnected, and a square wave voltage will be generated in the Squaring circuits and connected to the Filter circuits to shock excite the Filter into oscillation at the tuned frequency. A sinusoidal voltage at this frequency is then connected to the Amplitude Meter circuits. The resulting output voltage of these circuits is then fed back into the Squaring circuits. The output voltage of these circuits controls operation of the Frequency Meter and the external strob light. The Frequency Meter will indicate tuned frequency of the analyzer, and the strob light will flash at the same frequency up to 15,000 CPM. For tuned frequencies above 15,000 CPM, the strob light will flash at a scaled down rate (see values in Table A-1).

The supply voltage for operating the Model 345 Analyzer circuits can be obtained from a 117/234 VAC voltage supply or from the internal supply battery. If the analyzer operation is being checked, it must be operated from an AC voltage supply. If operated from the internal battery, the strob light should not be flashed unless the battery is charged to 4.4 volts, or greater. If the battery is fully charged, its output voltage will be 5.4 volts. Use of the strob light should be minimized when on battery power because this light will consume a considerable amount of power.

A.1.1 VOLTAGE SUPPLY CIRCUITS

The Voltage Supply circuits, as illustrated in Figure A-2, consist of both AC and battery operated circuits. Two fuses are used, F1 protects the analyzer circuits from the 117/234 VAC voltage supply, and F2 protects these circuits from the battery voltage.

If the analyzer is operated from the 117/234 VAC supply voltage, the voltage of the high-voltage winding of transformer T1 will be bridge rectified by D10, and filtered by capacitor C42. The voltage at C42, approximately +450 VDC, is used to flash the strob light. If the AC supply voltage is disconnected from the analyzer, the voltage charge on C42 will be discharged by resistor R92. The output voltage of the low-voltage winding of T1 is bridge rectified by D11, and filtered by capacitor C37. The voltage charge resulting on C37, approximately +24VDC, is regulated by Q8 to supply regulated +24 volts to operational amplifiers of the analyzer circuits, the Amplitude Meter circuits, and the +5 volt regulator Q9. This regulator supplies regulated +5 volts to the logic gates and Frequency Meter circuits. If the load current of either regulator should become excessively high, due to a component failure, the corresponding regulator will turn off automatically until the malfunction has been corrected.

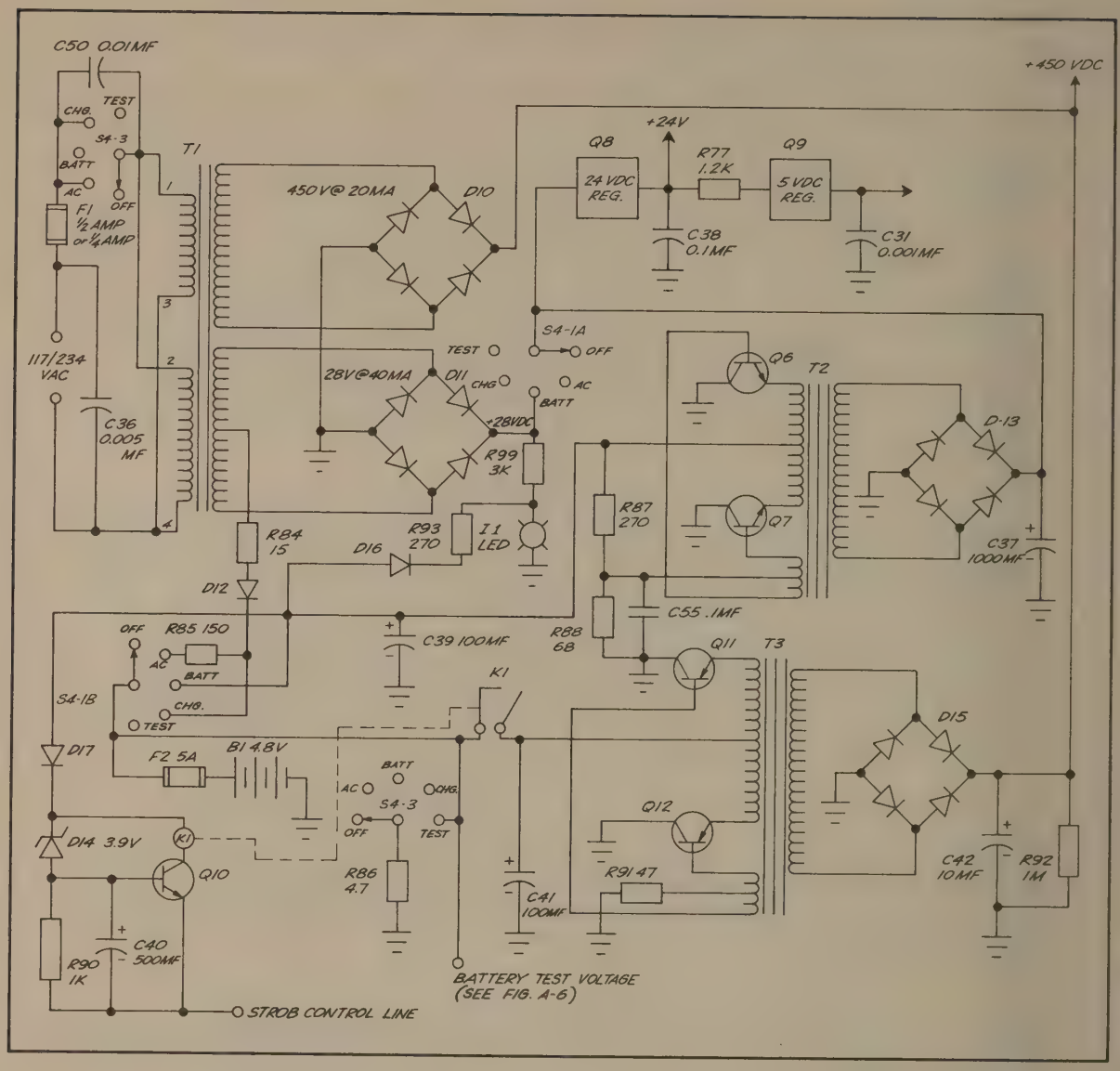


Figure A-2 Voltage Supply Circuits

The current for operating LED light I1, on the front panel, and for charging the internal battery is also supplied by the low-voltage winding of T1. When the analyzer is connected to the AC voltage supply, a very low charging current is connected to the battery to keep it fully charged. However, when the 345 is operated in the CHARGE mode, a much higher charging current is connected to the battery. In this mode, the battery will be fully charged in approximately 14 hours.

When the BATTERY mode-of-operation is used, all supply voltages to the 345 circuits are provided by the battery. This battery consists of a 4-cell Ni-Cad unit, its output voltage is 5.4

volts when fully charged, and has a 4 ampere-hour rating. If the battery were completely discharged, it would be ruined. Therefore, if its output voltage is low, the battery should be recharged as soon as possible. To recharge the battery, the 345 should be connected to the AC supply voltage, and operated in the CHARGE mode for approximately 14 hours.

The battery operates two square-wave oscillator voltage supplies (2K Hz frequency). One supply circuit provides +450 volts for flashing the strob light. The other supply circuit provides non-regulated +24 volts. This voltage is then regulated by Q8 and connected to the 345 operational amplifiers, the Amplitude Meter circuits, and to the +5 volt regulator, Q9. The +5 volts output from Q9 is used to operate the logic gates of the 345 circuits, and the Frequency Meter circuits. If the load current of either Q8 or Q9 is increased to an abnormally high value, the corresponding regulator will turn off automatically until the malfunction is corrected.

When the 345 is operated in the BATTERY mode, the +450 volt supply will be connected when the strob light switch is depressed. However, neither the strob light nor the +450 volt supply circuits can be operated if the battery voltage is 4.4 volts or less. When the strob light switch is depressed, the strob control line will ground the control circuit to relay K1. If the battery voltage is high enough to turn on Zener diode D14, transistor Q10 will also turn on. This will energize relay K1 and will connect the battery voltage to the +450 volt supply voltage circuits. The output voltage of these circuits will flash the strob light.

If the output voltage of the battery is reduced to 4.4 volts, or less, Zener diode D14 will not conduct. In this case, relay K1 will not be energized and the +450 volt supply will be disconnected. Therefore, the strob light cannot be flashed until the battery has been recharged.

When the 345 is operated in the TEST mode, R86 (4.7 ohms) will be parallel connected to Fuse F2 and the battery to provide proper loading of the battery. Resistor R45, the Amplitude Meter, and Zener diode D3 will be connected in series with one another and parallel connected across the battery and fuse F1 circuits as discussed above.

A.1.2 SIGNAL CONDITIONER CIRCUITS

The Signal Conditioner circuits, as illustrated in Figure A-3, receive the input signal voltage from the vibration pickup, see resistors R10 through R17. These resistors are connected in series with one another, and are inter-connected with the Amplitude Range switch as an attenuator. This attenuator suppresses the input voltage in steps of 10 dB. If the Amplitude Range switch is set to TEST, a fixed voltage is connected to the Signal Conditioner circuits. When this switch is in its

TEST position, the Amplitude Meter must indicate within the TEST ⎡~⎤ zone of the meter scale.

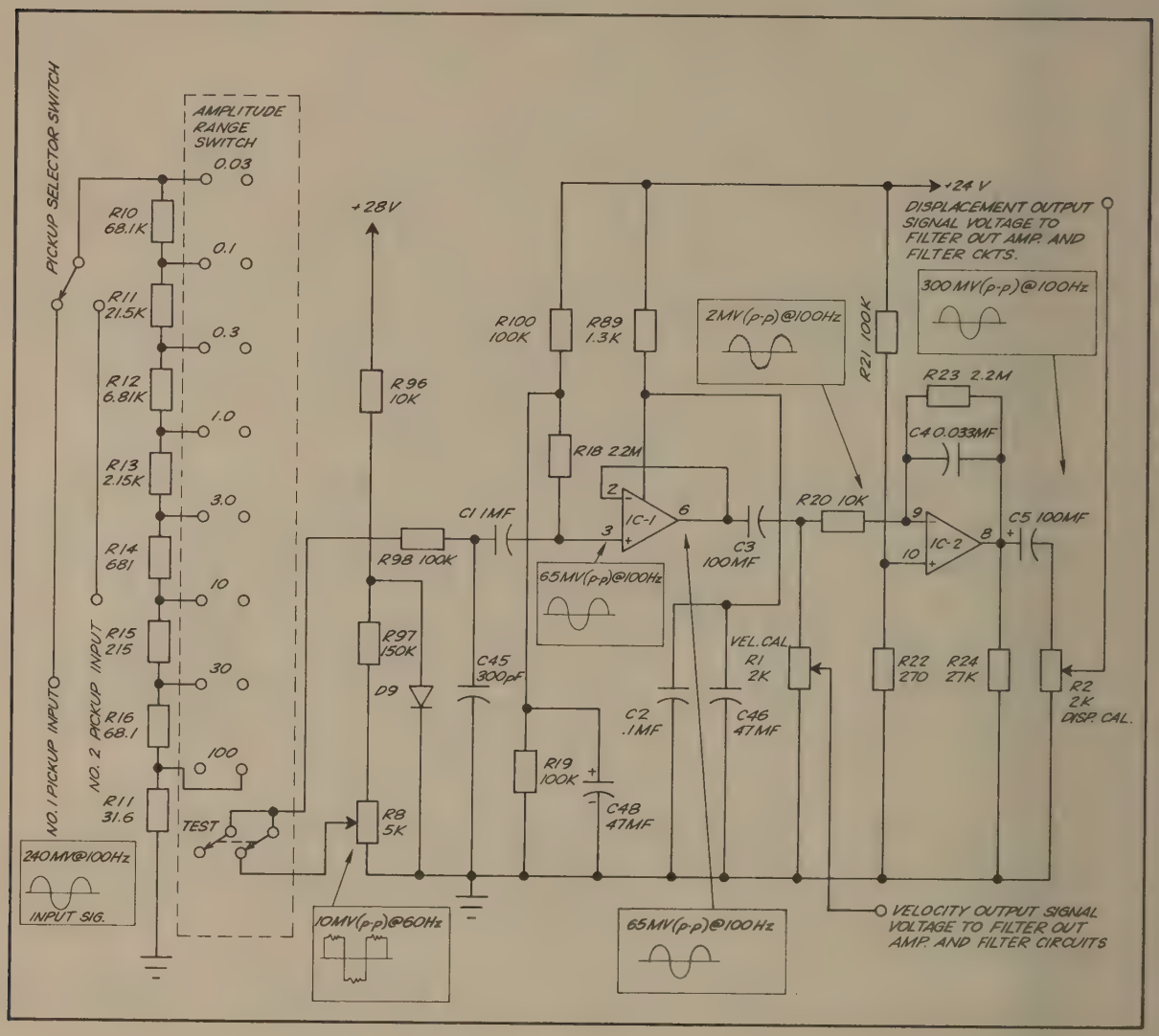


Figure A-3 Signal Conditioner Circuits

In Figure A-3, amplifier IC-1 consists of a low-noise device, it does not invert the input signal voltage, but buffers this voltage to eliminate scaling error which may occur in the attenuation. The sizing of resistor R98 and capacitors C1 and C45 causes IC-1 high-frequency roll off at approximately 1.67 K Hz (100,000 CPM), and low-frequency roll off at approximately 2 Hz. Capacitors C46 and C2 decouple the low frequency and high frequency noise voltages. The output of IC1 provides a Velocity signal voltage on potentiometer R1. The level of this signal voltage is determined by the setting of R1. This voltage is connected to the Filter Out Amplifier and Filter circuits.

A.1.3 FILTER OUT AMPLIFIER CIRCUITS

The Filter Out Amplifier circuits, illustrated in Figure A-4, are used only in the FILTER OUT mode-of-operation. Either the velocity or displacement input signal voltage can be connected to these circuits, as shown in Figure A-4. The input signal voltage is amplified by IC2 to provide a signal gain equivalent to the amount of gain provided by the Filter circuits. The gain of IC2 is determined by the setting of the Filter Out Calibrate potentiometer R3. When R3 is properly set up, the gain of IC2 will be approximately 20 to 22. However, gain settings of 24 to 44 can be obtained.

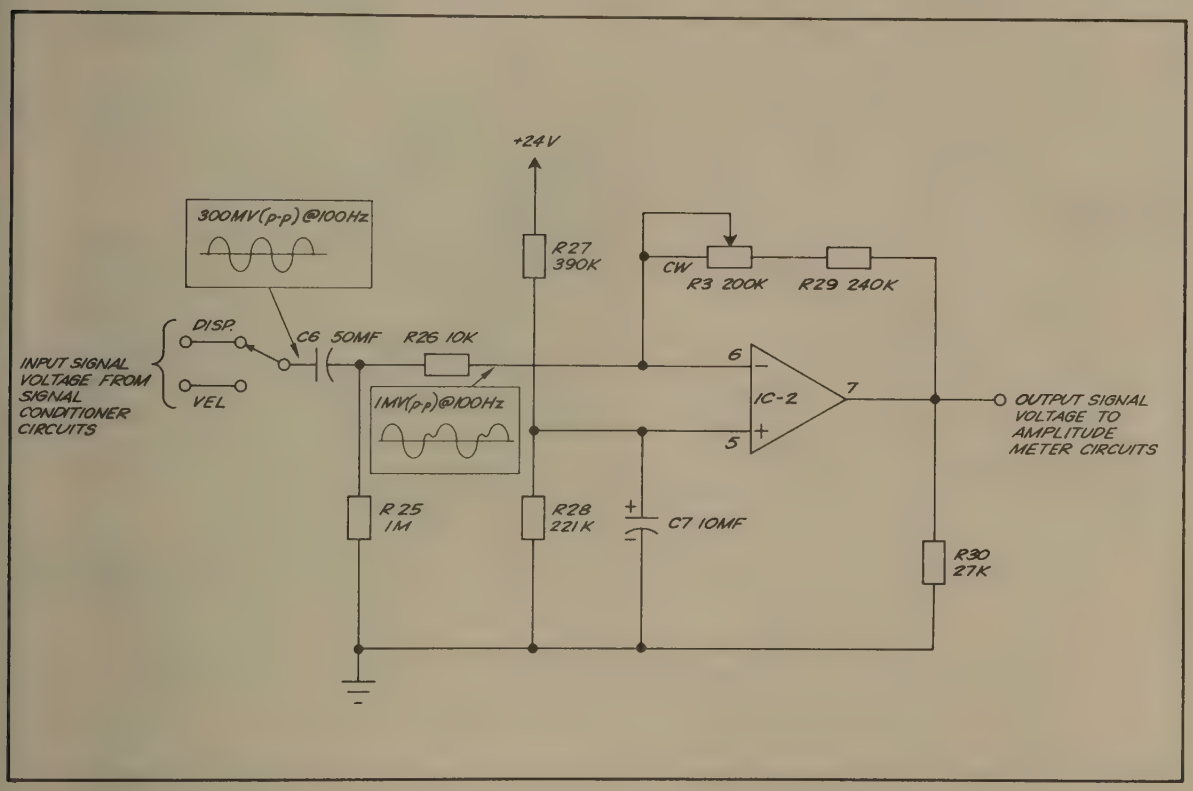


Figure A-4 Filter Out Amplifier Circuits

A.1.4 FILTER CIRCUITS

The Filter circuits, as illustrated in Figure A-5, consist of a band pass filter which is used in only the FILTER IN and OSC (Oscillator) modes-of-operation to provide a tuned frequency of output signal voltage. The overall tunable frequency band of these circuits is from 100 to 100,000 CPM and is divided into three selectable ranges: 100 to 1,000 CPM, 1,000 to 100,000 CPM, and 10,000 to 100,000 CPM. The frequency range is determined by setting of the Frequency Range -CPM- control. The Filter Tuning control setting determines the tuned frequency.

In the FILTER IN mode-of-operation, the input signal voltage to the Filter circuits comes from the Signal Conditioner circuits, (see Figure A-3). Depending upon the position of the DISP-VEL selector, the input signal voltage may be for measurement in DISPLACEMENT or VELOCITY. When setup for the desired frequency range and tuned frequency, the output voltage at pin 7 of IC3 will consist of a sinusoidal voltage at the tuned frequency. This output signal voltage is connected to the Amplitude Meter Amplifier circuits, discussed in Section A.1.5, to control operation of the Amplitude Meter.

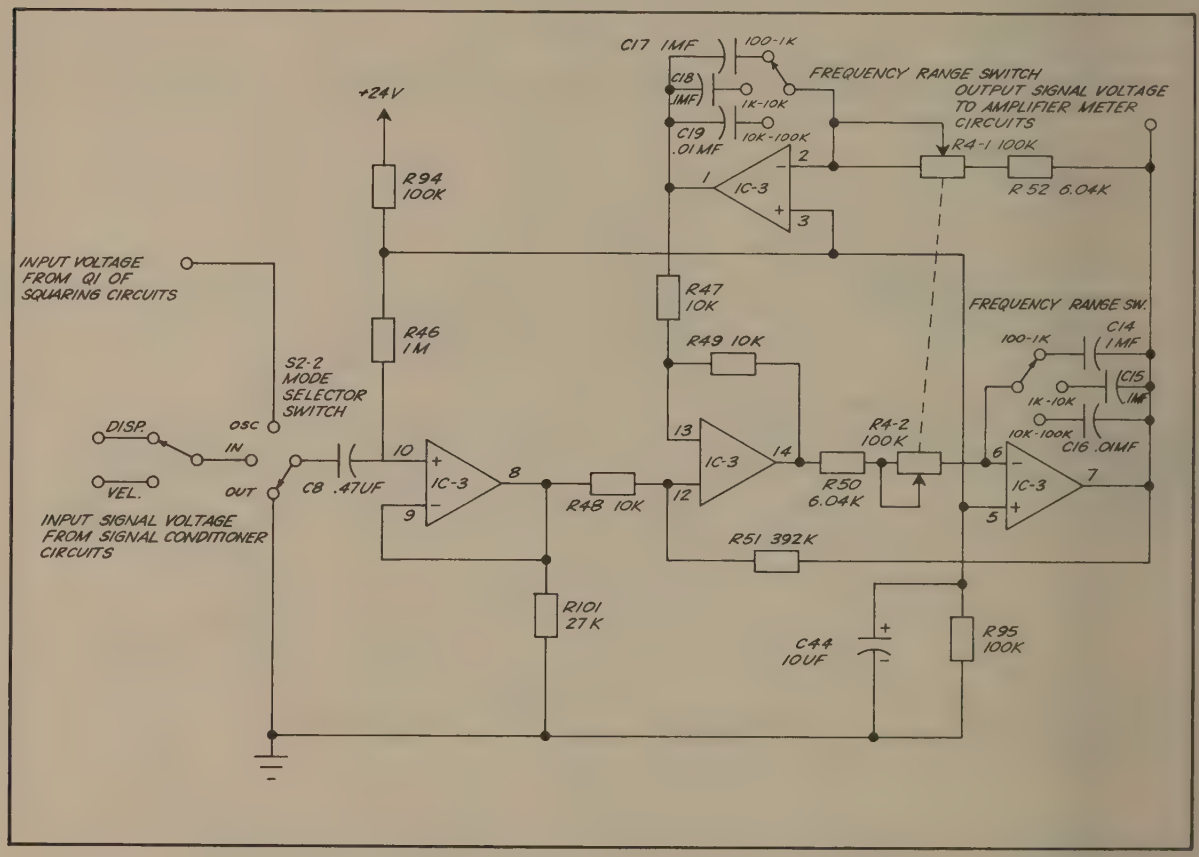


Figure A-5 Filter Circuits

In the OSC (Oscillator) mode-of-operation, a square wave voltage is connected from the Squaring circuits (see Section A.1.6) to the Filter circuits to shock excite these circuits into oscillation at the tuned frequency. A sinusoidal output voltage at the tuned frequency is then provided by the Filter circuits for connection to IC2 of Figure A-6. The voltage resulting at pin 1 of IC2 is further processed by the Squaring, Strob Scaling, and Frequency Meter circuits, see Sections A.1.4, A.1.5, and A.1.6. The resulting signal voltages provided by these circuits provides indication of the tuned frequency on the Frequency Meter, and strob light flashing at the desired frequency.

A.1.5 AMPLITUDE METER CIRCUITS

The Amplitude Meter circuits, as illustrated in Figure A-6, consist of an amplifier and an active rectifier. The output at pin 1 of IC2 provides an AC signal voltage for connection to an external oscilloscope. This voltage is also connected to the Squaring circuits, explained in Section A.1.6. If an input of 240 mv, rms, at 100 Hz is connected to pin 2 of J1, an output of 8.0 V, p-p, will be supplied at J4, Scope Jack. The output at pin 14 of IC2 supplies the current for operating the Amplitude Meter in the FILTER OUT and FILTER IN modes.

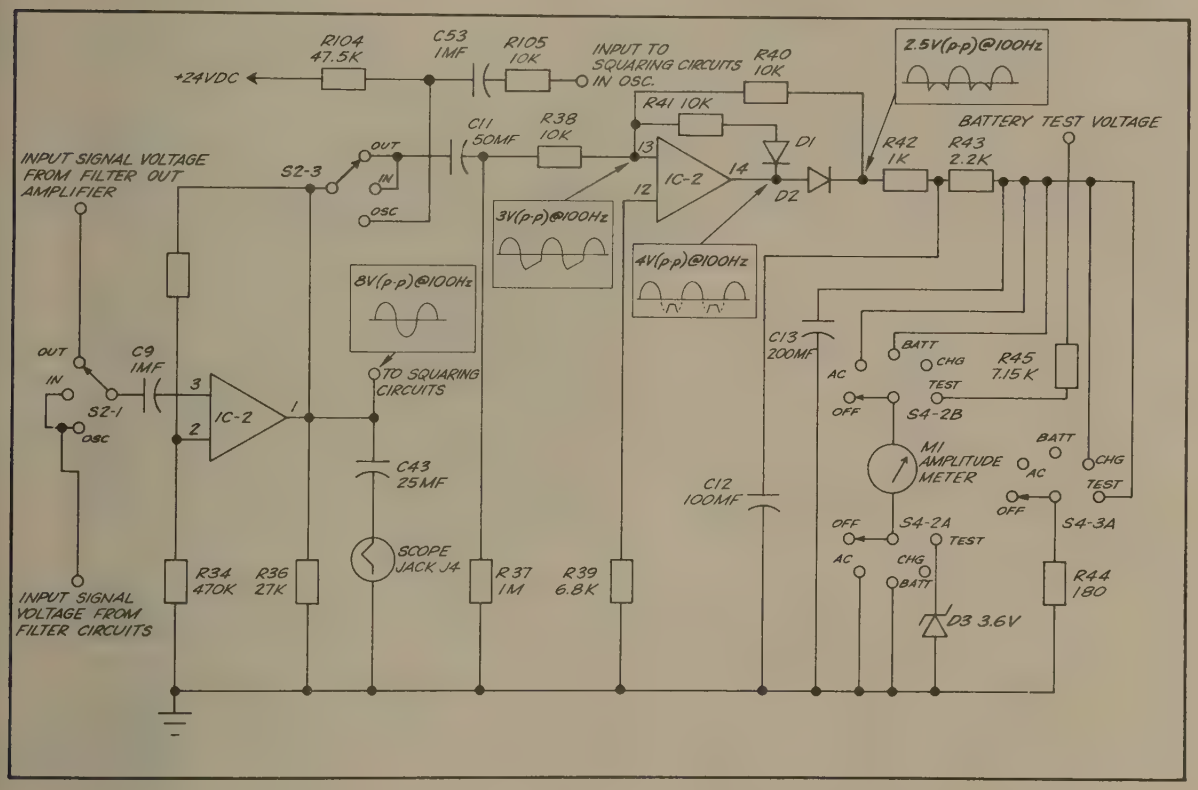


Figure A-6 Amplitude Meter Circuits

If operated in the FILTER OUT mode, the AC output voltage at pin 1 of IC2 is connected to the Squaring circuits (Sect. A.1.6). These circuits provide a DC voltage pulse for connection to the Strob Scaling circuits (Sect. A.1.7) and the Frequency Meter circuits (Sect. A.1.8). The output of the Strob Scaling circuits controls the flash rate of the external strob light, and the output from the Frequency Meter circuits controls the Frequency Meter. The output voltage at pin 1 of IC2 (Fig. A-6) is also connected to pin 13 of IC2, and the output resulting at pin 14 of this IC is half-wave rectified by diode D2 to charge up C13. The average DC voltage to which C13 is charged will determine the vibration level indicated on the Amplitude Meter.

If operated in the OSC (Oscillator) mode, the Amplitude Meter will be disconnected. A square wave voltage will be connected from the Squaring circuits to the Filter circuits to shock excite the Filter into oscillation at the tuned frequency. The Filter circuits then supply a sinusoidal voltage at this frequency for feed back into the Squaring circuits. These circuits then supply a pulsating voltage, at the tuned frequency, to the Strob Scaling and Frequency Meter circuits. The Strob Scaling circuits (Sect. A.1.7) control the flash rate of the external strob light. The Frequency Meter circuits (Sect. A.1.8) will provide indication of the tuned frequency value on the Frequency Meter.

NOTE: The tuned frequency value can be read more accurately from the Frequency Meter than from the Filter Tuning Dial.

Resistor R44, which is parallel connected with capacitor C13, supplies a dummey load for the Amplitude Meter to prevent C13 from charging to an abnormally high voltage when switching from TEST or CHARGE to AC or BATTERY. This protects the Amplitude Meter from being overloaded.

If operated in the TEST mode, resistor R45 and Zener diode D3 will be connected in series with the Amplitude Meter, and the supply battery will be connected in parallel with the TEST circuits. In effect, the scale of the Amplitude Meter is expanded to provide a battery voltage reading at an up-scale point on this meter. The low end of the BATTERY TEST ZONE indicates a battery voltage of approximately 4.25 volts. The high end of the test zone indicates a battery voltage of approximately 5.44 volts.

Amplitude of the AC signal voltage at pin 1 of IC2 can be checked by connecting an oscilloscope at J4 (see Figure 2-2, Page 2-4). In FILTER OUT, with an input of 240 mv, rms, at 100 Hz at J1, an output of 8.0 V, p-p, should be indicated on the oscilloscope, and a full-scale indication should be shown on the 0 to 1 scale of the Amplitude Meter.

A.1.6 SQUARING CIRCUITS

The Squaring circuits, as illustrated in Figure A-7, consist of a Schmitt-Trigger circuit and an output driver. The Schmitt-Trigger circuit will provide a sharp square-wave voltage at the tuned vibration or oscillator frequency. The output driver will provide buffering of the output voltage to prevent over loading of the Schmitt-Trigger circuit. Operation of the Squaring circuits is identical in the FILTER OUT, FILTER IN, and OSC modes.

In the FILTER OUT mode, a composite vibration signal voltage will be amplified by IC2, pin 1 (Fig. A-6), and connected to the Squaring circuits. A square wave voltage at the predominant vibration frequency is then generated by the Schmitt-Trigger

circuit, and buffered by the output driver. The resulting pulsating voltage is connected to the Strob Scaling and Frequency Meter circuits for operating the strob light and Frequency Meter.

In the FILTER IN mode, the vibration voltage at the tuned frequency is connected to the Squaring circuits. Otherwise, the operation of these circuits is identical to that described in the preceeding paragraph for FILTER OUT.

In the OSC (Oscillator) mode, the vibration signal voltage is disconnected. However, the output voltage of Q1, Fig. A-7, is coupled to the Filter circuits to shock excite these circuits into oscillation at the tuned frequency. The output voltage of the Filter circuits is then amplified and then connected to the Squaring circuits. The resulting output voltage at the driver of these circuits is connected to the Strob Scaling and Frequency Meter circuits. It is used to control the flash rate of the strob light and the indication of the Frequency Meter.

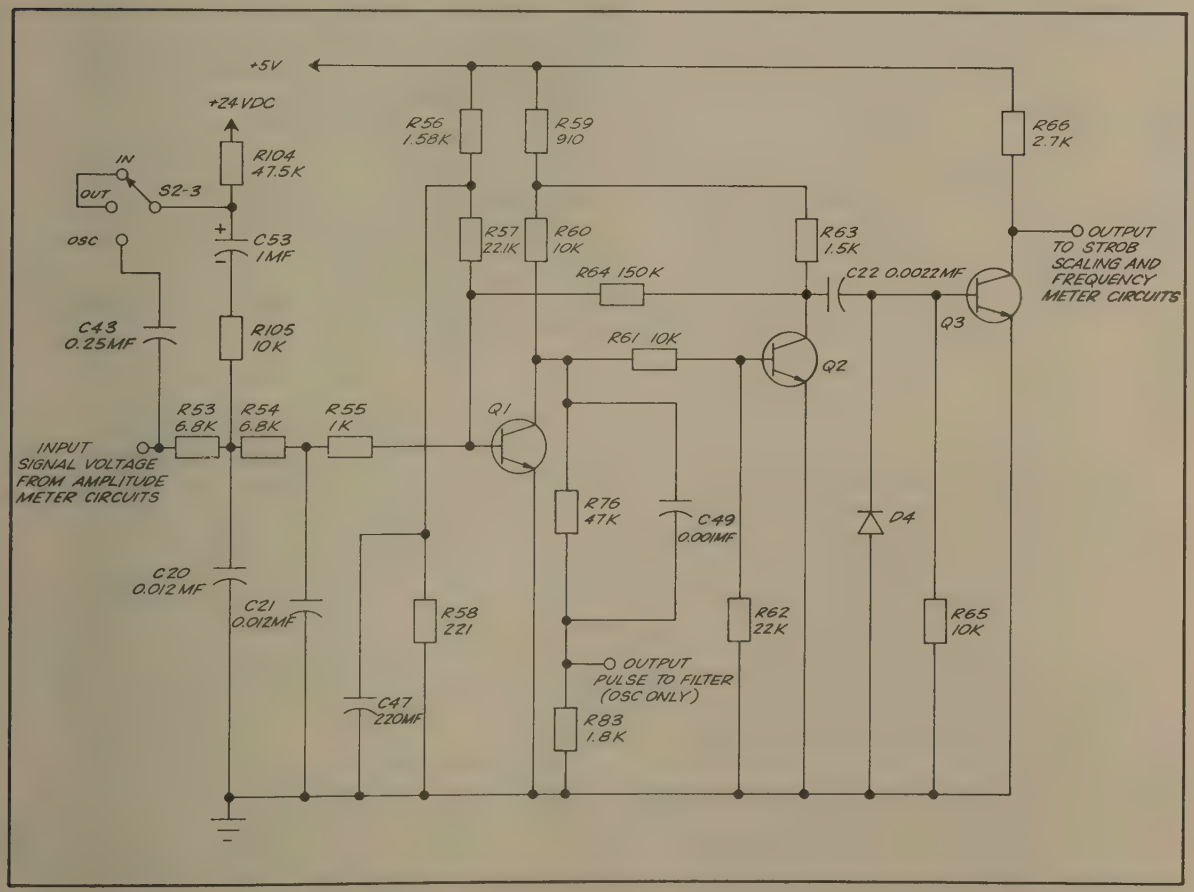


Figure A-7 Squaring Circuits

A.1.7 STROB SCALING CIRCUITS

The Strob Scaling circuits, illustrated in Figure A-8, scale the flash rate of the external strob light to the values shown in Table A-1.

TABLE A-1 STROB LIGHT FLASH RATE SCALING

TUNED FREQUENCY VALUES IN CPM	FLASH RATE SCALING
From 1 to 15,000	Flashes at Tuned Frequency
15,000 to 30,000	1/2 of Tuned Frequency
30,000 to 45,000	1/3 of Tuned Frequency
45,000 to 60,000	1/4 of Tuned Frequency
60,000 to 75,000	1/5 of Tuned Frequency
75,000 to 90,000	1/6 of Tuned Frequency
90,000 to 100,000	1/7 of Tuned Frequency

The output voltage pulse of the Squaring circuits is connected to the Strob Scaling circuits at pin 1 of IC4. When positive-going, this voltage pulse will provide a logic LOW at pin 3 of IC3. Each side of capacitor C25 will also go LOW until C25 is charged up. Pins 5, 6, 8, 9, 12, and 13 of IC4 will also go LOW, and pins 4, 10, and 11 of this IC will go to a logic HIGH level. These logic states will not change until C25 is charged up to approximately +2.5 volts. The logic HIGH at pins 10 and 11 of IC4 enables Q5 (an SCR) to conduct. Capacitor C28 will then discharge through Q5 to provide one flashing of the strob light. When C25 is charged up to approximately +2.5 volts, the logic state at pins 4, 10, and 11 of IC4 goes from HIGH to LOW, pin 3 of IC4 goes from LOW to HIGH, and Q4 stops conducting. This operational cycle will be repeated when the next positive going voltage pulse is received at pin 1 of IC4.

The amount of strob flash rate scaling provided by the Strob Scaling circuits is determined by the input signal frequency and the amount of time required for C25 to charge up to +2.5 volts. With signal frequencies of from 1 to 15,000 CPM, C25 will charge up to this voltage before the next signal pulse is received, and the strob will flash at the same frequency. At signal frequencies above 15,000 CPM, C25 will not charge up to +2.5 volts until one or more input signal pulses have been received. Therefore, the flash rate of the strob light will be scaled down to a sub-multiple of the input signal frequency. The flash rate values for each band of input signal frequencies are listed above in Table A-1.

NOTE: Capacitor C28 will charge up quickly when Q5 is not conducting to provide a flashing voltage for the strob. The voltage value to which C28 is charged is determined by the values of resistors R73 and R74. When Q5 is conducting, it connects C28 in series with a high-voltage transformer located inside the strob light to flash (ionize) this light.

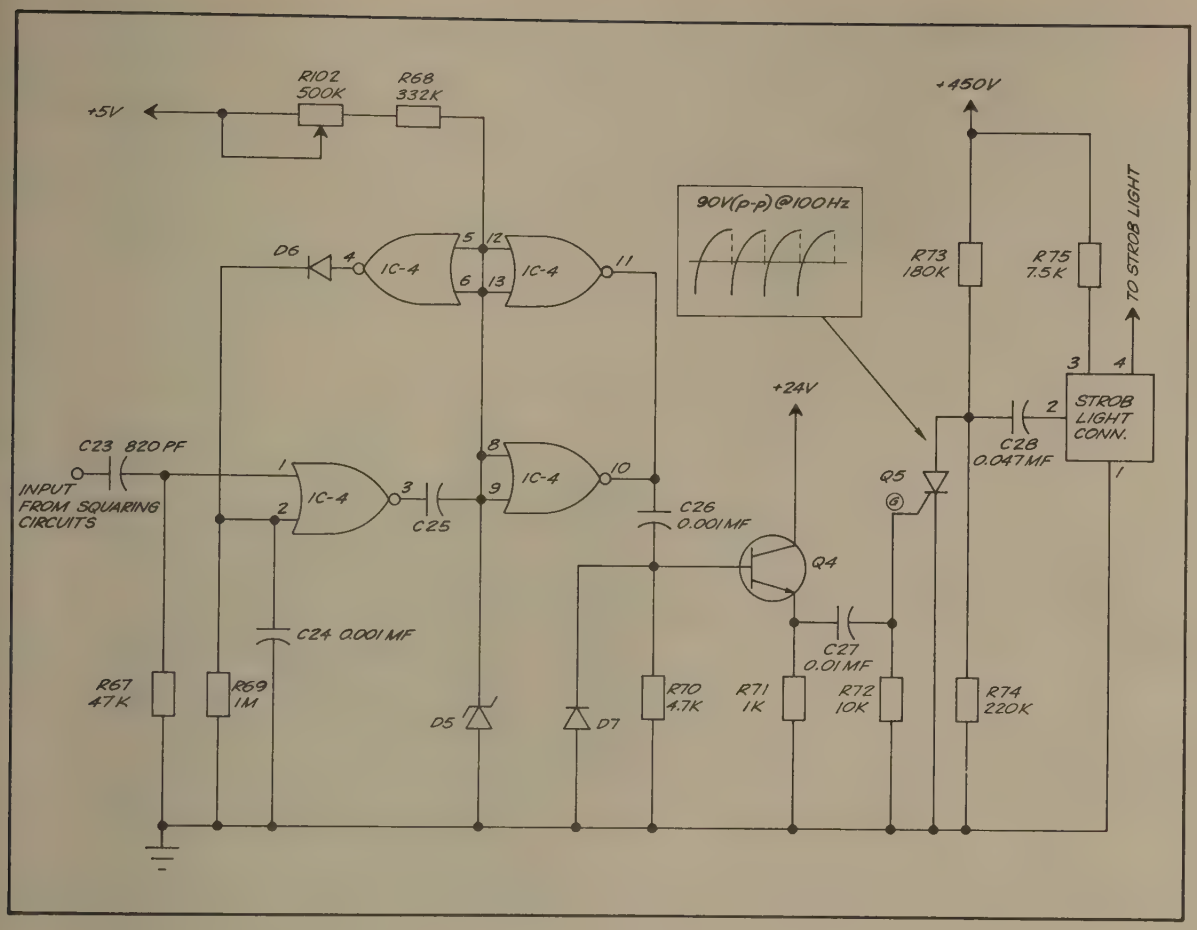


Figure A-8 Strob Scaling Circuits

A.1.8 FREQUENCY METER CIRCUITS

The Frequency Meter circuits, illustrated in Figure A-9, consist of a Schmitt-Trigger circuit with three adjustable load ranges, and two parallel-connected output logic gates. These circuits provide the required indications on the Frequency Meter, and are operated in the FILTER OUT, FILTER IN, and OSC modes.

In Figure A-9, the output voltage pulse of the Squaring circuits is connected to pin 1 of IC5. When this voltage pulse is received, the voltage at pin 3 of IC5 will go to the logic LOW level, and the voltage at pins 4, 10, and 11 of this IC will go to the logic HIGH level. The HIGH voltage at pin 4 of IC5 will maintain these logic states until capacitor C32 has charged up to approximately +2.5 volts. Capacitor C35 will attempt to charge up through R82. The average voltage to which C35 is charged is determined by the frequency of the voltage pulses connected to the Frequency Meter circuits, this voltage value determines the frequency indicated on the Frequency Meter.

When capacitor C32 has charged up to approximately +2.5 volts, the voltage at pins 4, 10, and 11 of IC5 will go back to the locic LOW level. Since the input voltage at pin 1 of IC5 will have gone from HIGH to LOW by this time, the LOW at pin 4 will cause pin 3 of this IC to again go to the logic HIGH level. The LOW at pins 10 and 11 of IC5 will interrupt the charging of capacitor C35 until the next input voltage pulse is received from the Squaring circuits, when received, the operational cycle described above will be repeated.

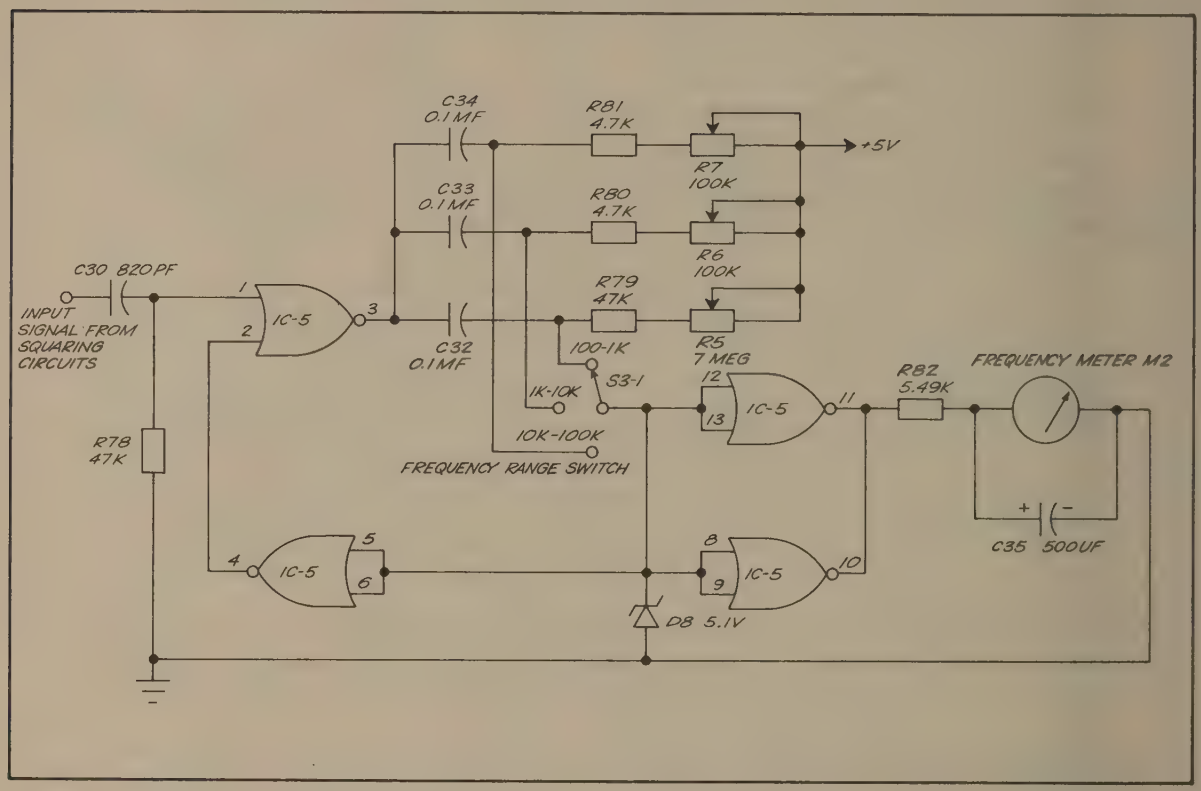


Figure A-9 Frequency Meter Circuits

The rectangular output voltage pulses supplied at pins 10 and 11 of IC5 will occur at either the predominant vibration frequency, the tuned vibration frequency, or the tuned oscillator frequency. These pulses will charge up capacitor C35 to a voltage value proportional to the operating frequency. The Frequency Meter indication will be determined by the average voltage value to which C35 is charged. A measured quantity of operating time called the "duty cycle" is used to determine the frequency value indicated on the Frequency Meter for a given rate of input. The Frequency Meter circuits have been designed to provide a Frequency Meter indication at the extreme high end of its calibrated scale when the charging voltage is connected to R82 and C35 during approximately 70 percent of the "duty cycle".

A.2 TROUBLE SHOOTING INFORMATION

Before attempting to troubleshoot the analyzer, components such as the vibration pickups, interconnecting cables, cable connectors and receptacles, and fuses should be checked. In addition, check the position of all setup controls. If the analyzer is being operated from its internal battery, make certain that the battery is charged sufficiently. Always try to maintain the battery at a full-charge of 4.8 volts, and do not permit it to be completely discharged, since this would ruin the battery. Check the operation of the analyzer in its "test" [~] mode, and note any erroneous meter indications obtained. If the Amplitude Meter indications are too high or low in this mode, check the calibration (see Section A-3).

A.2.1 TROUBLE SHOOTING TIPS

The amplitude of the voltage at the Scope Output Jack, J4, should be 8.0 volts, p-p, and the Amplitude Meter should indicate full-scale, on the 0 to 1 scale, with an input of 240 mv, rms, at 100 Hz connected at the vibration pickup receptacle, when operated in velocity and FILTER OUT with an Amplitude Range setting of 0.3.

The functional operation of the Voltage Supply, Voltage Converters, Voltage Regulators, Filter, Squaring, Frequency Meter, and Strob Scaling circuits can be tested by programming the analyzer through its entire frequency spectrum, 100 to 100,000 CPM, in OSC with both the AC and BATTERY supply voltages.

The operation of the Low Voltage Supply, Low Voltage Converter, 24 Volt Regulator, Signal Conditioner, Filter OUT Amplifier, and Amplitude Meter Circuits can be tested in TEST [~] and in FILTER OUT (with both AC and BATTERY supply voltage) by setting the Amplitude Range control to 100, connecting the vibration pickup and cable to the analyzer, and hand shaking the pickup to generate an input signal. However, make certain that the pickup cable is functioning correctly.

To provide an input signal at a known amplitude and frequency, an audio signal generator should be used in place of the vibration pickup, and any erroneous meter indications obtained should be recorded, and then related to the circuit operations analyzed in Section A.2.3.

If desired, the IC component sockets on the internal PC Board can be used as test points for measuring signal levels and supply voltages. In addition, when the supply voltage has been disconnected, the IC components can be disconnected from the PC Board receptacles, and the receptacle contactors can be used as test points for checking circuit continuity, resistance values, etc., of associated circuit components. This technique will provide many shortcuts and conveniences in trouble-shooting.

A.2.2 TEST EQUIPMENT REQUIRED

In addition to the services of a competent electronics technician the following test equipment is required for trouble shooting the analyzer circuits.

1. Oscilloscope, Techtronics, Model 503 or equivalent.
2. Audio Signal Generator, H-P, Model 202C or equivalent.
3. AC Digital Voltmeter, H-P, Model 403A or equivalent.
4. Frequency Digital Counter, H-P, Model 5300A, 5302A, or equivalent.
5. Vibration Pickup cable, IRD Part No. 4521.

A.2.3 TROUBLE SHOOTING PROCEDURE

Table A-2, which follows, contains a list of sequential trouble shooting Symptoms, Possible Causes, and Suggested Cures. Before performing suggestions listed in this Table, check operation in the TEST mode, and also check for correct calibration as instructed in Section A.3.

SYMPTOM	POSSIBLE CAUSES	SUGGESTED CURES
The ON OFF light will not come on in AC.	1. Power cord is defective	1. Replace Power cord, IRD P/N 2914.
	2. Blown AC fuse.	1. Replace fuse F1, P/N 1511, .5 Ampere for 117 VAC; P/N 5276, 0.25 Ampere for 230 VAC.
The ON OFF light will not come on in BATTERY.	1. Battery voltage is low.	1. Recharge battery.
	2. Blown BATTERY fuse.	1. Replace fuse F2, P/N 3849, 5.0 Amperes.
Amplitude Meter indication LOW, HIGH, or ZERO in FILTER OUT.	1. IC1 defective.	1. Replace IC1, Fig. 5-1, P/N 9692.
	2. IC2 defective.	2. Replace IC2, Fig. 5-1, P/N 12194.
Amplitude Meter indication LOW or ZERO in FILTER OUT.	1. IC1 defective.	1. Replace IC1, Fig. 5-1, P/N 9692.
	2. IC2 defective.	1. Replace IC2, Fig. 5-1, P/N 12194.
	3. IC3 defective.	1. Replace IC3, Fig. 5-1, P/N 12194.

TABLE A-2 CONTINUED

SYMPTOMS	POSSIBLE CAUSES	SUGGESTED CURES
	4. Defective contact in S4.	1. Repair or replace S4, Fig. 5-1, P/N 12152.
	5. Defective contact in S2.	1. Repair or replace S2, Fig. 5-1, P/N 12150.
	6. Defective VEL-DISP switch.	1. Replace switch S6, Fig. 5-1, P/N 12153.
Amplitude Meter indication above or below 0.5 on 0 to 1 scale in TEST [~].	1. Integrator IC2 in the Signal Conditioner circuits is not operating correctly.	1. Set S6 to VEL and check Amplitude Meter. If it indicates approximately 0.1 on 0-1 scale, IC2 is not operating correctly or R2 needs resetting. Check setup of R2, see Page A-22, Steps 1, 2, and 3. Also check IC2 and associated circuits. If ok, replace IC2, Fig. 5-1, P/N 12194.
	2. IC1 buffer in Signal Conditioner circuits not operating correctly.	1. Set S2 to VEL and check Amplitude Meter. If meter indicates 0.1 on 0-1 scale, IC1 operation is ok. If meter indicates above or below 0.1 on 0-1 scale, IC1 or associated component is defective, or R1 needs resetting, see Steps 4 and 5, Page A-22. If R1 setup is ok, replace IC1, P/N 9692, see Fig. 5-1.
Amplitude Meter indicator fluctuates too much in TEST, FILTER IN, and FILTER OUT (fluctuation of ±2 minor divisions is ok).	1. IC1 is noisy.	1. Replace IC1, Fig. 5-1, P/N 9692.
	2. IC2 is noisy.	1. Replace IC2, Fig. 5-2, P/N 12194.
Indications on Amplitude and Frequency Meters are both unstable.	1. 24-Volt and 5-Volt regulators not regulating supply voltages.	1. AC voltage supply too low; provide higher voltage. 2. Replace rectifier D11, Fig. 5-1, P/N 3565.

TABLE A-2 CONTINUED

SYMPTOMS	POSSIBLE CAUSES	SUGGESTED CURES
		3. Replace capacitor C37, Fig. 5-1, P/N 12193.
		4. Repair low voltage converter (BATTERY mode only) input of 27 VDC (min) to regulator is required.
	2. Defective pickup cable.	5. Replace pickup cable, P/N 4521.
Amplitude and Frequency meter indications are unstable in FILTER IN and OSC when tuning Dial is rotated.	1. Dual pot. R4-1 and -2 either noisy or defective. NOTE: Amplitude meter not used in OSC.	1. Clean arm of R4A and R4B with contact cleaner. 2. Replace R4, Fig. 5-1 P/N 12184.
Amplitude and Frequency Meters indicate ZERO(0) in AC or BATTERY.	1. 24 V. regulator turned off due to excess load.	1. Shut off 345. Turn back on two minutes later. If malfunction is repeated, either 24 or 5 VDC supply is shorted. Disconnect 345 from supply voltages and check for shorted component. Replace defective component.
Frequency Meter and strob light will not operate in AC or BATTERY.	1. No output at pin 1 of IC2.	1. Check for output at Scope Jack with scope or AC voltmeter. If no output is obtained, check for output at pin 1 of IC2 in FILTER OUT, or at pin 1 of IC3 in FILTER IN. If no outputs are obtained, replace C43, Fig. 5-1, P/N 5027.
	2. Defective transistor in Squaring circuits.	1. Replace Q3, Fig. 1, P/N 4826. 2. Replace Q2, Fig. 1, P/N 4583. 3. Replace Q1, Fig. 1, P/N 4583.

TABLE A-2 CONTINUED

SYMPTOMS	POSSIBLE CAUSES	SUGGESTED CURES
Strob will not operate in BATTERY with full charge of 4.8 volts, and K1 is operative.	1. Relay contacts dirty or pitted.	1. Clean and burnish relay contacts. 2. Replace relay K1, Fig. 1, P/N 9241.
	2. Defective high voltage converter.	1. Repair high voltage converter. NOTE: The high voltage converter, if operating, will make an audiable high-frequency tone. If this tone is present, the converter is operating.
	3. Defective lamp in strob light.	1. Replace strob lamp, P/N 8461.
	4. Defective strob light cable.	1. Replace strob light cable, P/N 8653.
Strob will not operate in AC.	1. Defective high voltage supply.	1. Repair high voltage supply.
Strob will not operate in BATTERY.	1. Battery voltage is low.	1. Recharge battery.
	2. Relay K1 contacts dirty or pitted.	1. Clean and burnish relay contacts, or replace relay, P/N 9241.
	3. Defective high voltage converter.	1. Replace high voltage converter, P/N 12160.
Strob will not operate in AC or BATTERY.	1. Defective strob lamp.	1. Replace strob lamp, P/N 8461.
	2. Defective strob cable.	1. Replace strob cable, P/N 8653.
	3. Defective IC4.	1. Replace IC4, Fig. 5-1, P/N 9923.
	4. Defective Q4.	1. Replace Qr, Fig. 5-1, P/N 4826.

TABLE A-2 CONTINUED

SYMPTOMS	POSSIBLE CAUSES	SUGGESTED CURES
(continued)	5. Defective Q5 (SCR).	1. Replace Q5, Fig. 5-1, P/N 4587.
	6. Regulator Q9, 5 vdc, is shut off from excessive load current.	1. Check for shorted component in Squaring, Strob Scaling, and Frequency Meter circuits, and replace shorted component.
	7. Strob Scaling circuits malfunctioning.	1. Check operation of Strob Scaling circuits per Section A.1.7, if circuits are malfunctioning, check for defective component, and replace defective component.

A-3 CALIBRATION

The Calibration of the Model 345 Vibration Analyzer consists of precise adjustment of five trim potentiometers located on the internal PC Board. The input and output signal voltages required in the calibration are measured respective to the analyzer chassis. The following test equipment is required for calibration:

1. Audio Signal Generator, H-P, Model 202C, or equivalent.
2. Digital AC Voltmeter, H-P, Model 403A, or equivalent.
3. Digital Frequency Counter, H-P, Model 5300A, 5302A or equivalent.
4. Vibration Pickup Cable, IRD Part No. 4521.

A.3.1 PRELIMINARY STEPS

1. Interconnect the calibration test equipment and the 345 vibration analyzer as illustrated in Figure A-10.

NOTE: Except for the vibration pickup cable, the Model 345 cables are not used in the calibration. When performing the calibration, the analyzer and all external test instruments must be set on a flat level surface, and the analyzer must be removed from its metal case.

2. Disconnect the AC supply voltage from the analyzer, and set up the analyzer controls as follows:

   A. Set Power selector to OFF.
   B. Set the ZERO control of Amplitude and Frequency Meter so that each meter indicates ZERO "0". These

controls are accessible through the holes in the Front Panel beneath the meters.

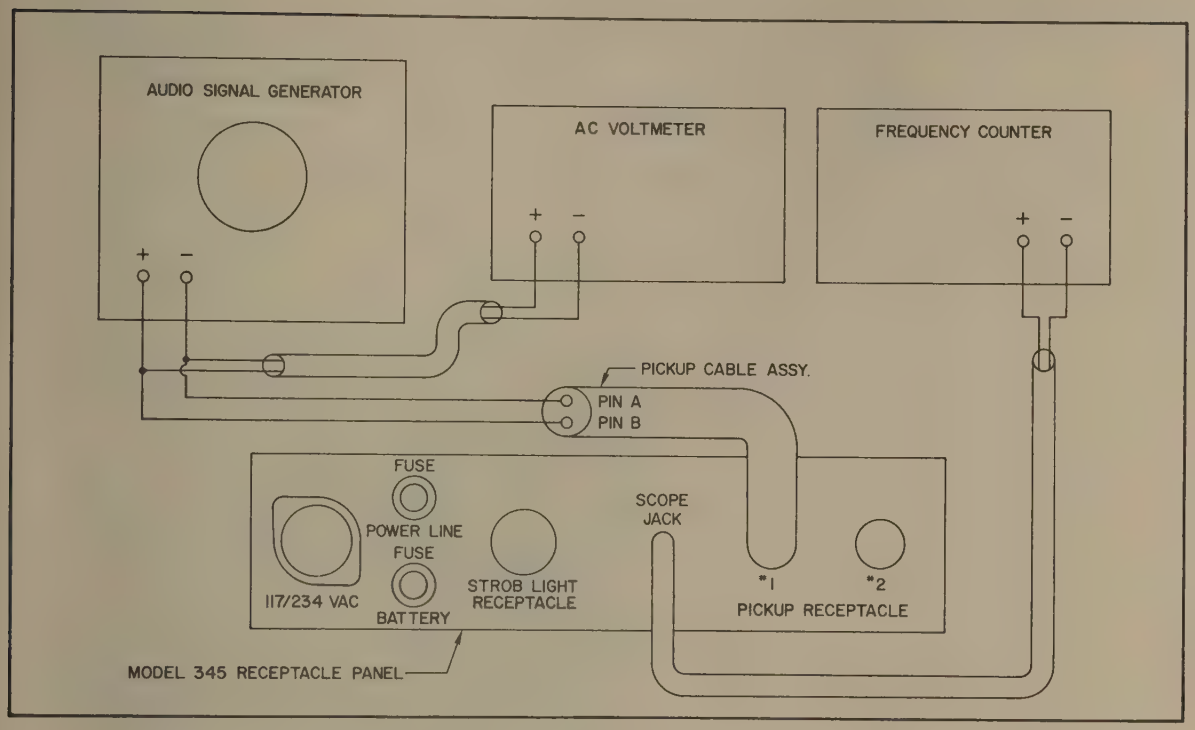


Figure A-10 Diagram for Test Equipment Connection

3. Connect the AC supply voltage line to the 345 power line receptacle, then allow five minutes for warmup.

4. Set the Power selector (Fig. 2-1) to TEST, then check that the Amplitude Meter indicates near the high end of the "Battery Test Zone" [BATTERY] on the meter scale. An indication at or above 0.8 of the upper scale indicates that the internal battery is sufficiently charged up to operate the analyzer dircuits.

5. Check that the pilot light of the 345 comes on when the Power selector is set to BATTERY or AC.

A.3.2 CALIBRATION PROCEDURE

The vibration analyzer circuits are to be calibrated from the AC signal voltage of the audio signal generator. If the calibration is to be varified from the vibration signal voltage of the Model 544 Vibration Pickup, a Model 421 Vibration Pickup and System Tester must be used with the pickup to provide known levels of vibration amplitude at a constant frequency. The Model 345 Vibration Analyzer should be calibrated as follows (see instructions beginning on Page A-22).

1. Set up the analyzer and calibration instruments as follows:

   A. Set the signal generator output signal amplitude to 240 mv (289 mv for metric units),rms, and set up the frequency to 100 Hz. The amplitude is read from the digital voltmeter, and the frequency from the digital frequency counter.

   B. Set the Pickup selector to 1.

   C. Set the Power selector to AC.

   D. Set the Vel-Disp selector to DISP.

   E. Set the Filter selector to IN.

   F. Set the Amplitude Range selector to 1 (set to 30 in metric units).

   G. Set the Frequency Range- CPM selector to 1K-10K.

2. Adjust the Filter Tuning Dial so that a peak indication is provided on the Amplitude Meter.

3. Adjust R2, DISPLACEMENT GAIN control, see Figure A-11, so that an indication of 1 of upper scale is obtained on the Amplitude meter (in metric units, set R2 for an indication of 3 on the lower scale of Amplitude Meter).

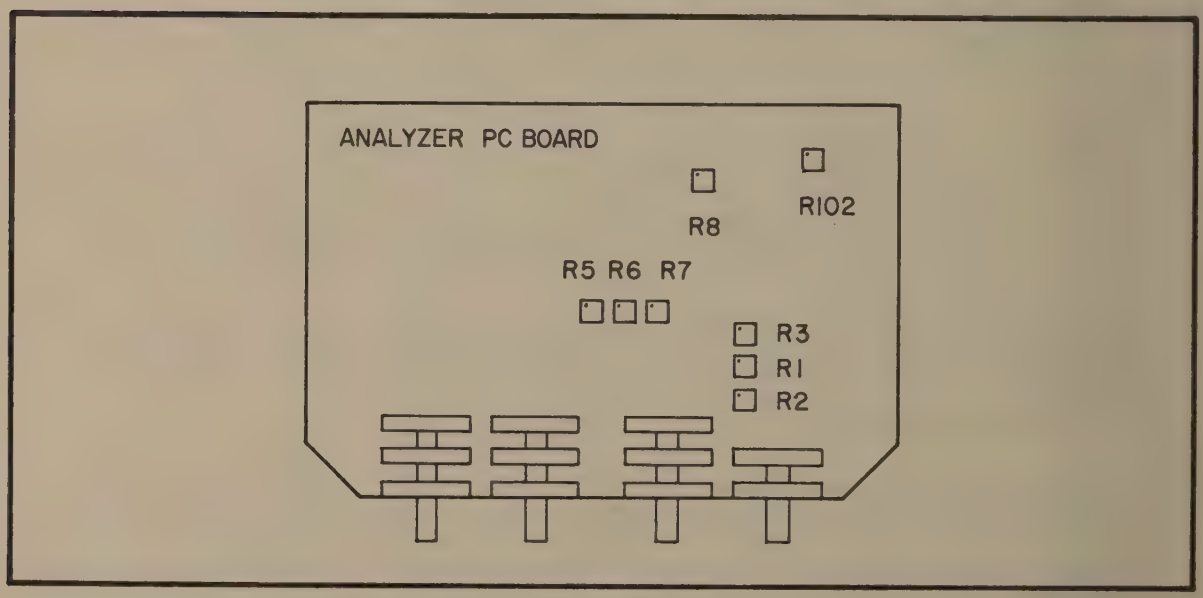


Figure A-11 Locations of Calibration Controls

4. Set the Disp-Vel selector to VEL and the Amplitude Range selector to 0.3 (set to 10 in metric units).

5. Adjust R1, VELOCITY GAIN control, see Figure A-11, for an indication of 1 on upper scale of the Amplitude Meter (set for indication of 3 on lower scale of Amplitude Meter in metric units).

6. Set the Filter selector to OUT, then adjust R3, FILTER OUT GAIN control, see Figure A-11, for an Amplitude Meter indication of 1 on upper scale (set R3 for indication at 3 on lower scale of Amplitude Meter in metric units).

7. Seal the controls of R1, R2, and R3 (Fig. A-11) so that the calibrated settings will be retained.

8. Set up the analyzer controls as follows:

   A. Set the Power selector to AC.

   B. Set the Amplitude Range selector to TEST.

   C. Set the Disp-Vel selector to DISP.

   D. Set the Filter selector to OUT.

   E. Set the Frequency Range- CPM selector to 1K-10K.

9. If the supply voltage frequency is 60 Hz, adjust R8, TEST SIGNAL control, see Figure A-11, so that the Amplitude Meter indicates at the center of the ⎡∼⎤ test mark on the meter scale (if supply voltage frequency is 50 Hz, set R8 for indication at 0.41 on upper scale of meter).

10. If the supply voltage frequency is 60 Hz, adjust R6, FREQUENCY METER control, see Figure A-11, so that the Frequency Meter indicates 3600 CPM, precisely (if the supply voltage frequency is 50 Hz, set R6 for a meter indication of 3000 CPM).

11. Seal the controls of R6 and R8 (Fig. A-11) so that the calibrated settings will be retained.

If desired, the calibrated settings of potentiometers R5 and R7 (see Figure A-11) can be checked by resetting the signal generator frequency control, and the analyzer set up controls to the values listed in the following table (the frequency, CPM, value to be indicated on the Frequency Meter for each range are included in the table).

(See table at top of Page A-24.)

FREQUENCY METER CALIB. CONTROL POTENTIOMETER REFERENCE NO.	AMPLITUDE RANGE CONTROL SETTING	FREQUENCY RANGE-CPM CONTROL SETTING	SIGNAL GENERATOR INPUT SIG. FREQUENCY	CPM INDICATION REQ'D. ON FREQ. METER
R5	1 MIL/3 MM	100-1K	14 HZ	840 CPM
R7	1 MIL/3 MM	10K-100K	1400 HZ	84,000 CPM

If desired, the Amplitude Meter indication can be checked for each Amplitude Range, by setting the Amplitude Range selector to the desired range and setting the signal generator output voltage to the value required for this range. Tables A-3 and A-4 contain two values of signal voltage and two corresponding values for indication on the Amplitude Meter for each Amplitude Range. Table A-3 is used with English units, and Table A-4 with Metric units.

TABLE A-3 AMPLITUDE CHECK VALUES FOR ENGLISH UNITS

AMPLITUDE RANGE (MILS)	SIGNAL VOLTAGE REQD.(RMS)		AMPL. METER IND.	
	LOW END	HIGH END	LOW END	HIGH END
0.03	2.4 mv	6 mv	0.01	0.025
0.1	6.0 mv	18 mv	0.025	0.075
0.3	24 mv	60 mv	0.1	0.25
1.0	60 mv	180 mv	0.25	0.75
3.0	240 mv	600 mv	1.0	2.5
10.0	600 mv	1.8 volts	2.5	7.5
30.0	1.2 volts	6.0 volts	5.0	25.0
100	6.0 volts	18.0 volts	25.0	75.0

TABLE A-4 AMPLITUDE CHECK VALUES FOR METRIC UNITS

AMPLITUDE RANGE (MICRONS)	SIGNAL VOLTAGE REQD.		AMPL. METER IND.	
	LOW END	HIGH END	LOW END	HIGH END
1	2.4 mv	7.2 mv	0.25	0.75
3	4.8 mv	24 mv	0.5	2.5
10	24 mv	72 mv	2.5	7.5
30	72 mv	240 mv	7.5	25.0
100	240 mv	720 mv	25.0	75.0
300	720 mv	2.4 volts	75.0	250.0
1000	2.4 volts	7.2 volts	250.0	750.0
3000	7.2 volts	24.0 volts	750.0	2500.0

A.3.3 CHECKING STROB LIGHT FLASH RATE SCALING

The STROB SCALING control, R102, (Figure A-11) is used to calibrate the Strob Scaling circuits to the desired frequency at which the external strob light is operated. These circuits are designed to scale the flash rate to one half the tuned frequency at 251±1 Hz (15060±60 CPM).

To check the flash-rate scaling, set the Filter selector to OSC, the Frequency Range-CPM selector to 10K-100K, and connect the external frequency counter to the Scope Output receptacle of the analyzer. Tune the analyzer so that the frequency counter indicates exactly 251 Hz. Then operate the external strob light and listen carefully to the audiable tone produced by this light.

Readjust the FILTER TUNING DIAL so that 250 Hz is indicated on the frequency counter while listening carefully for a change in the audiable tone. When the analyzer is tuned to 250 Hz, the strob should flash at the tuned frequency. However, when the analyzer is tuned to 251 Hz, the strob should flash at 1/2 the tuned frequency. The frequency at which the flash rate change occurs can be determined from the two audiable tones. The tone produced at 250 Hz will have a much higher pitch than the tone produced at 1/2 of 251 Hz. If the change in the strob flash rate occurs at 251±1 Hz, R102 is correctly set.

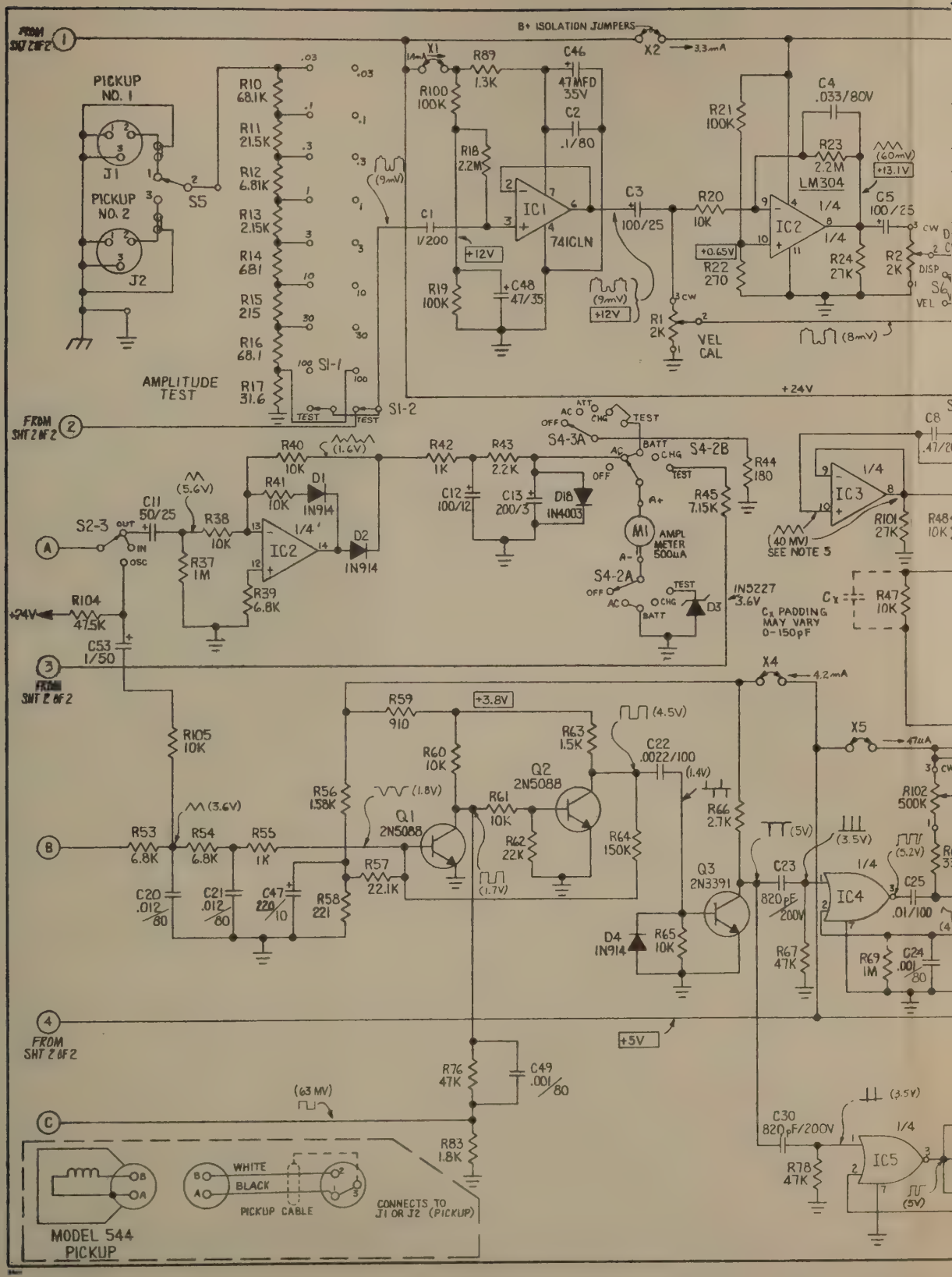
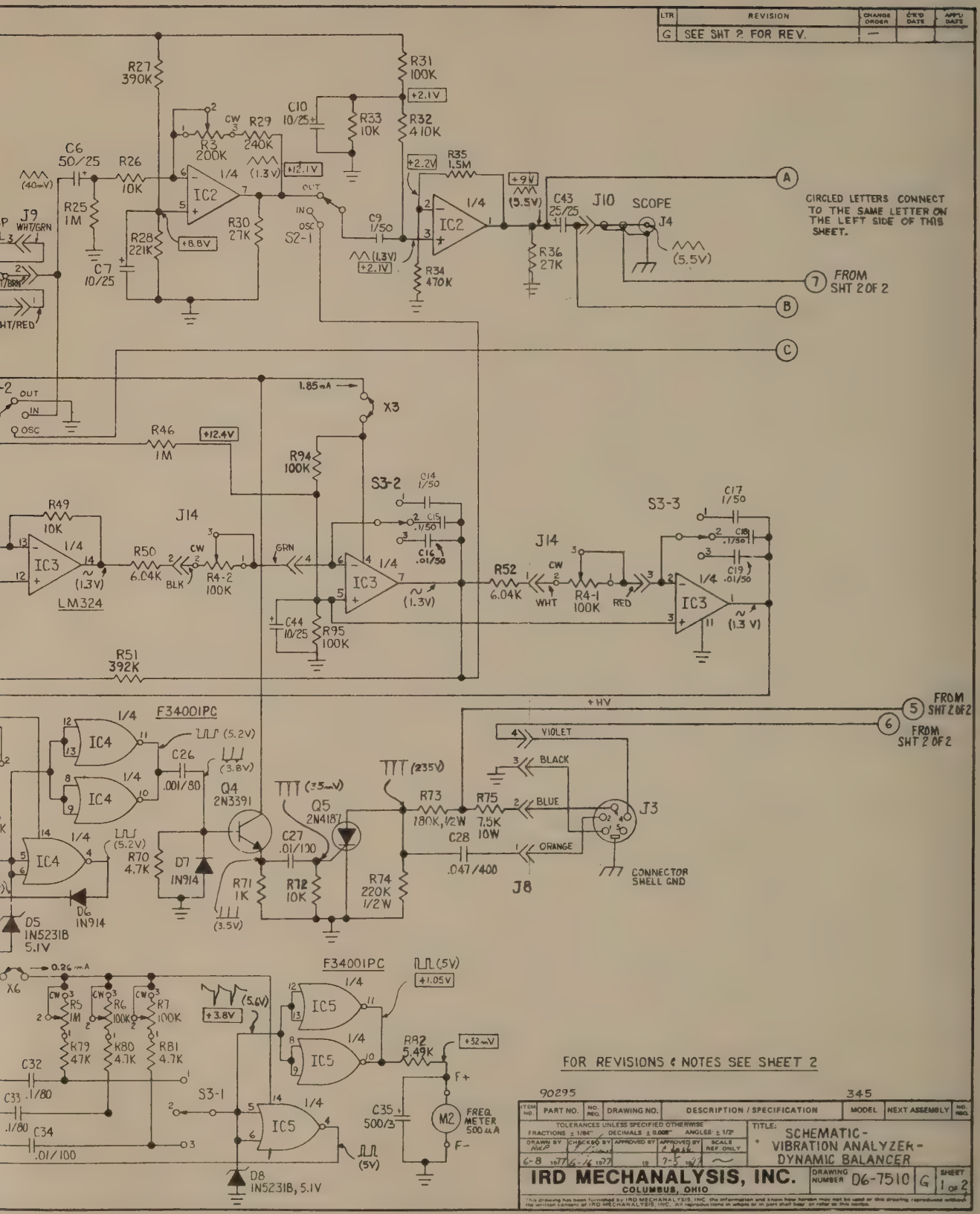
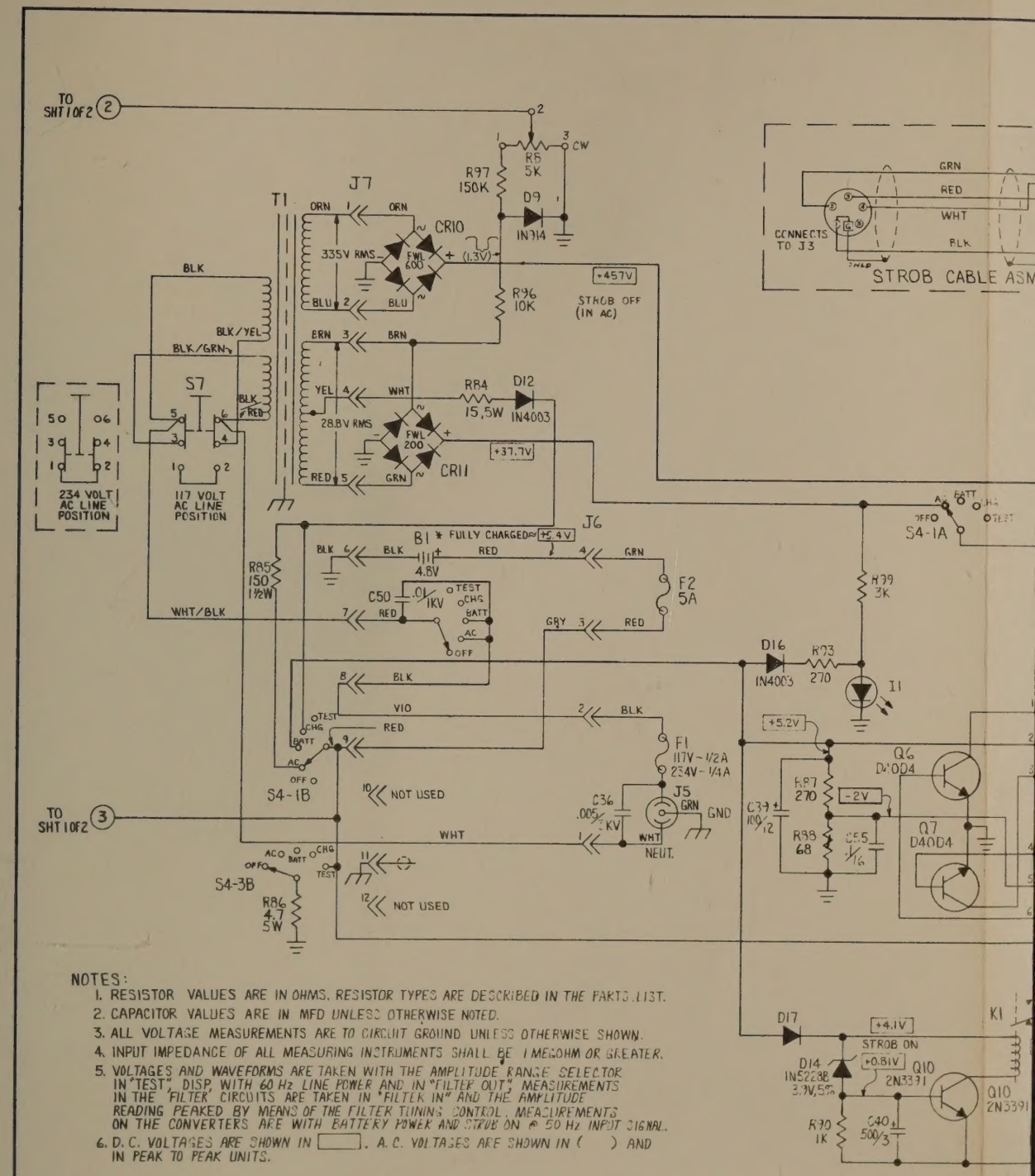


Figure A-12A Overall Electrical Sc

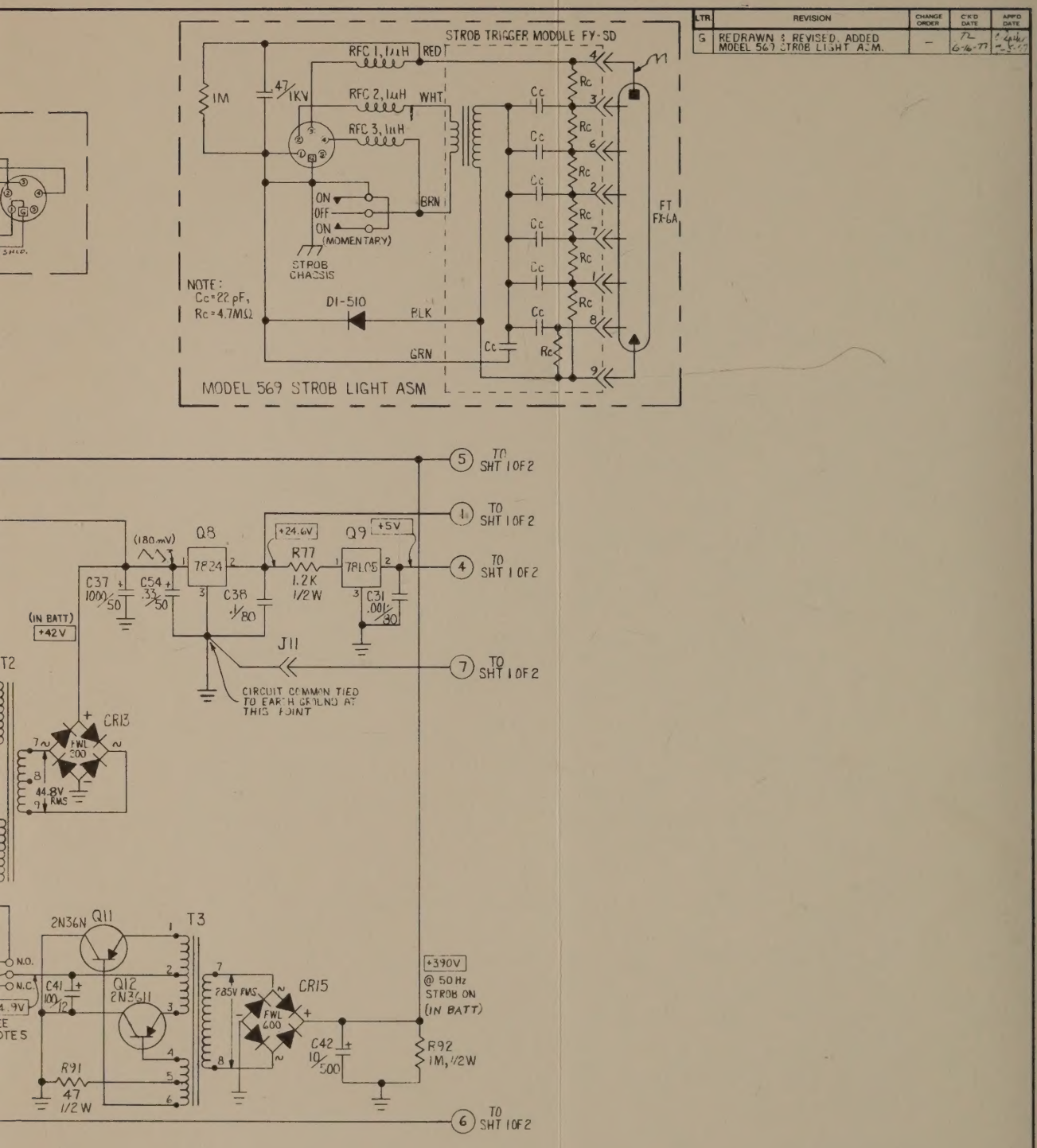

LTR REVISION CHANGE ORDER CHK'D DATE APP'D DATE
G SEE SHT 2 FOR REV.
CIRCLED LETTERS CONNECT TO THE SAME LETTER ON THE LEFT SIDE OF THIS SHEET.
FROM SHT 2 OF 2
SCOPE
J4
J10
IC2
IC3
IC4
IC5
LM324
F34001PC
S3-1
S3-2
S3-3
S2-1
X3
X6
J14
J3
J8
Q4 2N3391
Q5 2N4187
D5 IN5231B 5.1V
D6 IN914
D7 IN914
D8 IN5231B, 5.1V
CONNECTOR SHELL GND
FOR REVISIONS & NOTES SEE SHEET 2
90295
345
TITLE: SCHEMATIC - VIBRATION ANALYZER - DYNAMIC BALANCER
IRD MECHANALYSIS, INC.
COLUMBUS, OHIO
DRAWING NUMBER D6-7510 G
SHEET 1 OF 2



NOTES:

1. RESISTOR VALUES ARE IN OHMS. RESISTOR TYPES ARE DESCRIBED IN THE PARTS LIST.
2. CAPACITOR VALUES ARE IN MFD UNLESS OTHERWISE NOTED.
3. ALL VOLTAGE MEASUREMENTS ARE TO CIRCUIT GROUND UNLESS OTHERWISE SHOWN.
4. INPUT IMPEDANCE OF ALL MEASURING INSTRUMENTS SHALL BE 1 MEGOHM OR GREATER.
5. VOLTAGES AND WAVEFORMS ARE TAKEN WITH THE AMPLITUDE RANGE SELECTOR IN "TEST", DISP. WITH 60 Hz LINE POWER AND IN "FILTER OUT", MEASUREMENTS IN THE "FILTER" CIRCUITS ARE TAKEN IN "FILTER IN" AND THE AMPLITUDE READING PEAKED BY MEANS OF THE FILTER TUNING CONTROL. MEASUREMENTS ON THE CONVERTERS ARE WITH BATTERY POWER AND STROB ON @ 50 Hz INPUT SIGNAL.
6. D.C. VOLTAGES ARE SHOWN IN [ ]. A.C. VOLTAGES ARE SHOWN IN ( ) AND IN PEAK TO PEAK UNITS.

Figure A-12B Overall Electrical Schematic



LTR	REVISION	CHANGE ORDER	C'K'D DATE	APP'D DATE
G	REDRAWN & REVISED. ADDED MODEL 569 STROB LIGHT ASM.	–	6-16-77	

FIND NO.	ITEM NO.	QTY REQ	U/M	DRAWING NO.	DESCRIPTION
FINISH:		SCALE		TOLERANCE UNLESS SPECIFIED OTHERWISE: XX ± .015 IN. XXX ± .005 IN. XX ± 0.38mm XXX ± 0.13mm FRACTIONS: ± ANGLES: ± 0.5°	TITLE: SCHEMATIC- VIBRATION ANALYZER- DYNAMIC BALANCER

DRAWN BY	CHECKED BY	APPROVED BY	APPROVED BY
K.S.P.			
6-8-77	6-16-77		

MODEL NO. 345

IRD Mechanalysis, Inc.
COLUMBUS, OHIO

ITEM NO. 90295 | DRAWING NUMBER D6-7510 | REV G | SHEET 2 OF 2

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Diagram, Sheet 2 of 2